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The Household Hazardous Waste Disposal Project was an interagency effort to reduce the amount of toxicants entering the environment by developing a control plan for the safe disposal of small quantities of household chemicals. This Summary provides an overview of this problem and the steps taken to develop the control plan. The legal framework controlling the contents, labelling, and disposal of household toxic substances is reviewed in some detail. A brief examination of the contents, health effects, and environmental fate of four classes of consumer products (pesticides, paint products, household cleaners, and automotive products) is provided. The literature was reviewed for studies which document the potential for environmental contamination from disposal of these consumer products through landfilling, septic tank, or sewerage system disposal. A synopsis is provided of the surveys and pilot project that were conducted in the local Seattle metropolitan area. Finally, the elements of the regional control plan are described along with recommendations for future action. Similar programs around the country are noted and contacts provided.

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SUMMARY REPORT

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Household Hazardous Waste Disposal Project

METRO

Metro Toxicant Program

Report No. 1A

Water Quality Division
August 1982

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ANNOUNCEMENT OF AVAILABILITY:

HOUSEHOLD HAZARDOUS WASTE DISPOSAL

- REPORTS -

Metro's Household Hazardous Waste Disposal Project has reviewed the problem of disposal of consumer products containing toxic or hazardous substances, tested the response of the public to this issue, and developed a regional control plan for the Seattle area. Much useful information from this effort has been assembled in five reports, as follows:

Report A: Summary (146 pages)

This report provides a comprehensive overview of the project, covering these topics -

1. project origins and objectives
2. discussion of the household hazardous waste problem
   - labelling and testing
   - legal framework
   - contents of products
   - effects in the environment
3. discussion of solutions to the problem
   - local investigations, including public opinion surveys and pilot project
   - local results: the regional control plan
   - what others have done
4. conclusions of the project and recommendations for future action.

Report B: Toxicants in Consumer Products (220 pages)

This report provides an in-depth investigation into the contents of toxic consumer products. Four classes of products are examined:

- pesticides
- paint products
- household cleaners
- automotive products

Commonly used products in these categories were researched, and their toxic ingredients investigated. Discussions on the products cover contents, quantities used, regulations governing them and documented or potential effects of disposal on the environment. Technical data, such as sources, toxicities, health hazards, on specific chemicals of concern are compiled in lengthy tables at the end of each product class section. Also included are a simplified overview of organic chemistry and a discussion on measurements of and differences between the two terms, toxic and hazardous.

Report C: Public Opinions and Actions (121 pages)

This document provides a detailed explanation of the pilot study that was conducted to aid in devising a regional control plan. The pilot study determined public awareness of and attitudes about the issues of toxic/hazardous substances in the home and their safe disposal, and determined actual response to a collection program in a short neighborhood test. The study consisted of an initial telephone survey; a three-week collection project for pesticides, solvents and used motor oil; and a follow-up telephone survey. Conclusions and recommendations, both for a regional control plan in the Seattle/King County Metropolitan area, and for other communities or municipalities interested in controlling household toxicants, are included.

Report D: SLEUTH: Educational Activities on the Disposal of Household Hazardous Waste (160 pages)

For use by teachers in Grades 4-12, SLEUTH is a collection of classroom activities that present the issues of household hazardous waste disposal in an exciting and innovative manner. Some of the activities include:

- Master Sleuth - the student as detective, tracking down where wastes go, and making appropriate choices
- problem solving exercises - acting out problems of toxic chemical disposal
- game: Disposal! - a fun way for students to explore these issues
- the big picture - series of activities designed to get the student thinking about the larger context
- supplemental activities, such as labelling exercises, chemistry activities and worksheets.

Report E: Directory [for Household Hazardous Waste Disposal in Seattle-King County] (40 pages)

This small document contains the specific Product Disposal Recommendations developed by the HHWD Committee and endorsed by the major agencies, businesses and organizations involved in the project. It also includes a brief summary of background information pertinent to questions on disposal in the local area and contacts for more information.

The Directory is written for people who receive inquiries from the public concerning what they should do with toxic household waste; it is not intended for direct use by the public.

SUMMARY REPORT

REPORT A
OF THE

HOUSEHOLD HAZARDOUS WASTE DISPOSAL PROJECT

METRO TOXICANT PROGRAM #1

by Susan M. Ridgley
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Toxicant Control Planning Section
Water Quality Division
Municipality of Metropolitan Seattle

U.S. Environmental Protection Agency
Grant #P-000233-01
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December, 1982

DISCLAIMER

Although the research or investigation described herein has been funded in part by the U.S. Environmental Protection Agency through grant No. P-000233-01 to the Municipality of Metropolitan Seattle (Metro), it has not been subjected to the Agency's peer and administrative review and therefore does not necessarily reflect the views of the Agency, and no official endorsement should be inferred.

FOREWORD AND ACKNOWLEDGEMENTS

HOUSEHOLD HAZARDOUS WASTE -- WHAT's IT ALL ABOUT? To most people, hazardous wastes are found only in Love Canal, in large industrial dumps or in streams or toxic chemicals flowing from factory outfalls. But hazardous waste is really any substance that, when disposed of, poses a risk (e.g., ignitable, toxic) to people or to the environment.

A wide range of household products fits such a definition: pesticides, automotive oil, solvents, household cleaners, antifreeze, and others. Some of the chemicals found in these products are known or suspected mutagens, carcinogens or teratogens. Often they are toxic to human beings, fish and wildlife in small amounts. Every day, literally tons of these chemicals are washed down drains or dumpted in the trash. Because they come from many small, diverse sources (households) rather than a few large, localized sources (industries), they are difficult to control and are not currently regulated.

In addition, sales of a number of household toxic substances--including certain pesticides and vinyl chloride-containing products--have been banned or severely restricted. Quantities of these banned products can still be found in people's homes. The average consumer has had no choice, until now, but to dispose of these toxic products in ways allowing their eventual release into the environment.

WHY IS METRO CONCERNED ABOUT HOUSEHOLD HAZARDOUS WASTE? As the regional agency responsible for water quality and sewage treatment in King County, Metro is interested in keeping the region's waters clean. Metro has initiated the Toxicant Pretreatment Planning Study, Toxicant Inventory Study and other related projects as part of its commitment to assess the presence, sources, fates and effects of toxic substances in the local waters. The studies will help Metro identify problems and formulate effective control programs for point and nonpoint sources of problem toxicants.

HOUSEHOLDS CONTRIBUTE SIGNIFICANTLY to wastewater flows to the sewage treatment plants and solid waste to landfills. House, garden and garage products, such as paints, preservatives, pesticides, antifreeze and oil, can contaminate local stormwater runoff and streams. While not large when compared to industrial contributions, household hazardous wastes can be a source of problem toxicants in local waters.

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BECAUSE OF THESE CONCERNS, METGRO HAS BEEN STUDYING this issue and its implications as part of its Toxicant Control Program. In 1981, Metro received a water quality management grant from the U.S. Environmental Protection Agency to develop a disposal plan for small quantities of household toxicants. The Household Hazardous Waste Disposal (HHWD) Project was established as an interagency effort, coordinated by Metro and based on a working committee representing governmental agencies, private businesses, environmental and public interest groups, and concerned citizens. The goal of the project was to reduce the level of toxicants entering the environment by providing a sollution to the problem of unsafe or improper disposal of household hazardous wastes.

THIS SUMMARY is the first part of the final report of the Household Hazardous Waste Disposal Project, which includes the following components (separately bound):

A. Summary,
B. Toxicants in Consumer Products
C. Public Opinions and Actions,
D. SLEUTH - Educational Activities,
E. Directory.

As its name suggests, Report A presents a summary of the contents of the three other reports: B - Toxicants in Consumer Products, C - Public Opinions and Actions and E - Directory. In addition, it contains an in-depth discussion on the laws and regulations that impinge on household hazardous waste, documentation of effects in the environment, and the final conclusions, recommendations for future action and regional control plan. We prepared this report so that people interested in the topic of household toxicants and their disposal could avail themselves of an overview of the topic, in one report, without having to wade through the detailed information found in the 360 pages of the other three documents.

Many people deserve acknowledgement for their contribution to the HHWD project. Of primary importance are the members of the HHWD committee, without whose perseverance and commitment this project could not have happened. We thank them all. In particular, we would like to acknowledge those who directly contributed to the reports (B-E) that are summarized here: Judy Fey, Chris Luboff, Claire Dyckman, Lolly Smith-Greathouse, Greg Bishop, Ray Carveth, Bob Freimark, Sue Mason, Julie Sellick and Pat Ewing.

WE HOPE YOU WILL FIND the Summary report to be interesting and informative. If you would like more information on the subject of toxic substances and hazardous wastes in the home, access to the other reports or information of related activities, please contact Metro at (206) 447-5885. Your comments are welcome.

David V. Galvin
Project Manager

Susan Ridgley
Project Coordinator

ABSTRACT

The Household Hazardous Waste Disposal Project was established as an interagency effort to reduce the level of toxicants entering the environment by developing a control plan for the safe disposal of small quantities of household chemicals. This Summary report provides an overview of the aspects of this problem that were examined, and the steps that were taken to develop the control plan. The legal framework which controls the contents, labelling and disposal of household toxic substances is reviewed in some detail. A brief examination of the contents, health effects, and environmental fate of four classes of consumer products (pesticides, paint products, household cleaners, and automotive products) is provided. In determining the extent of this problem, the literature was reviewed for studies which document the potential for environmental contamination from the disposal of these consumer products, through landfilling, septic tank or sewerage system disposal. A synopsis is provided of the results of the surveys and pilot project that were conducted in the local Seattle metropolitan area. Finally, the elements of the regional control plan are described, as well as the recommendations for future action that were developed. Similar programs around the country that have been developed are described, and contacts provided.

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SECTION I

HISTORY AND OBJECTIVES

A. PROJECT ORIGINS

A major focus of the Toxicant Program in Metro's Water Quality Division is the identification and control of sources of toxic substances in the wastewater treatment system and regional waters. One suspected or intuitive source identified early in the program was household wastes which contain many of the chemicals found in consumer products. An initial review of this topic, conducted in 1979 and early 1980, resulted in two publications, a report entitled Household Toxicants and Water Quality (Bennett and Galvin, 1980) and a brochure entitled Toxic Substances in Your Home (included).

Three conclusions came out of this initial work:

- There is a great deal of public interest in this topic;
- We barely scratched the surface on such subjects as product contents, chemicals of concern, and options for proper disposal; and
- The public was getting different disposal recommendations from different agencies.

An informal ad hoc committee made up of representatives of the agencies and businesses listed on the back of the Toxic Substances in Your Home brochure ("for more information...") was formed to address the third point. The committee decided to develop a directory containing product disposal recommendations agreed on by consensus for all the pertinent agencies, businesses and interest groups. Some work began on this effort but, because everyone was participating on a limited scale and no one group was pulling all the pieces together, little headway was made. In order to get this group effort well-organized and produce some definite results, Metro applied for and received a water quality management (Section 208) grant from the U.S. Environmental Protection Agency in the spring of 1981 to develop a disposal plan for household toxicants.

B. PROJECT OBJECTIVES AND TASKS

The grant-funded project was designed to develop a program which would ultimately "reduce the quantity of toxic substances entering the areawide waters from residential activities..." (Metro, 1981). Specific project objectives were:

- To outline the pollution problem associated with improper disposal of household hazardous wastes;
- To determine which options exist for proper disposal;
- To evaluate effectiveness in the Seattle area of one or more disposal options in a pilot study;
- To establish a coordinated policy among the agencies and businesses involved in household product sales, use, regulation and disposal for the proper disposal of the various types of toxicant-containing wastes; and
- To develop and explore ways to implement a disposal plan for the region.

Project tasks follow the same general outline as the objectives and can be summarized as constituting four phases: information gathering, testing, pulling-it-all-together, and implementing.

In the first phase, which consumed over half the year-long project, we conducted our background research to answer some of the following questions: What is in consumer products? What constituents can be considered toxic or hazardous? What documented or potential problems exist with their disposal? What laws and regulations affect the issue? What options exist for safe disposal?

Building on the information gathered in the first phase, we designed and ran a pilot study to test some disposal options in a real world situation: What does the public know or think about the issue of toxic product disposal? What will people actually do? Will various options in a regional plan work? The pilot study involved both public opinion surveys and a short field test.

The third phase was based on the results of the first two. Given what we now know about the products, their contents and their hazards, which products need to be controlled? Which can do the most harm through improper disposal? In the same manner, given what we now know of what the probable public response to a collection program would be, what kind of control plan would be the most effective in this area? This phase centered on examining preferred options and developing a workable program for the region, with recommendations for dealing with the various issues confronted.

The fourth phase, which was begun during the grant period but which will continue, is making the plan work: agreements from all identified actors, getting the word out to the public, running the collection program, and evaluating results.

This summary presents the highlights of our efforts. It explains what we learned from our research and pilot study, what we think it means, what should be done and how successful we have been in getting it done.

C. THE COMMITTEE

The key to the success of the project has been the Household Hazardous Waste Disposal Committee. This group, composed of representatives of government agencies, private businesses, service organizations, public interest groups and private citizens (as outlined in Table 1) participated actively in project planning and decision-making. Biweekly meetings, held for over a year, provided the focus for this process, while extensive minutes enabled everyone to keep up-to-date and involved. Of primary importance in this process was the committee structure: it was not an advisory committee, but a working and decision-making body without which the project would not have functioned. The work plan for the grant made that clear: "All project tasks will be performed by committee members, or staff with committee direction. All major project decisions will be made by the committee" (Metro, 1981). The fact that this plan worked and that the diverse groups represented on the committee participated actively -- and intensely -- over a long period of time and reached concensus on major decisions, reflects positively on the project's structure. The committee was given authority to make decisions as well as responsibility to do much of the work. As a result, members felt ownership of the project and stuck with it to get the job done. The results of their efforts are presented in the rest of this summary report and in the other reports of this project. Results are also reflected in the position of an ongoing HHWD Committee as a critical component of our regional plan.

TABLE 1. AGENCIES, BUSINESSES AND ORGANIZATIONS REPRESENTED ON THE HOUSEHOLD HAZARDOUS WASTE DISPOSAL COMMITTEE

U. S. Environmental Protection Agency
U. S. Consumer Product Safety Commission
Washington Department of Ecology
Washington Office of Environmental Education
Seattle/King County Health Department
King County Office of Solid Waste
King County Cooperative Extension Service
Tacoma/Pierce County Health Department
Seattle Office of Solid Waste
Seattle Fire Department
City of Bellevue
Metro

Chemical Processors, Inc.
Chem-Security Systems, Inc.
Chemical Waste Management, Inc.
Ciba-Geigy, Inc.
Evergreen Nurserymen's Association

Poison Control Center

Washington Environmental Council
Seattle Audubon Society
League of Women Voters
Washington Citizens for Recycling
Washington P.I.R.G.
Western Washington Toxics Coalition

Puget Consumers Cooperative

Metro Citizens Water Quality Advisory Committee

Interested Citizens (no affiliation)

SECTION II

THE PROBLEM OF HOUSEHOLD HAZARDOUS WASTE

A. INTRODUCTION

The problem of household hazardous waste is roughly analogous to that being faced by industries in their handling of toxic substances. The industry (substitute "consumer") needs to know what the substance being used is, and have access to reliable information as to its dangers. It needs to know how use or misuse of the chemical substance can increase or decrease its hazards so that the worker will incur the least risk, and the industry needs to know how to safely dispose of those chemicals after their usefulness is over to prevent environmental harm and to avoid potential public health concerns.

Likewise, the problem of household hazardous waste can be viewed as three separate issues: 1) labeling and testing, 2) safe use, and 3) disposal. There is one crucial difference between industries and households in their handling of hazardous waste. Industries have the financial resources to invest millions of dollars to study and ultimately solve their waste problem. The householder, however, has no such resources to draw on when attempting to solve his problem. With limited technical expertise, little available information and no established guidelines, the consumer must resort to either a hit-or-miss procedure in dealing with his household toxicants, or not think about whether the usual practices are dangerous and thus remain unaware of the consequences of his disposal habits.

1. Labeling and Testing

The issues of labeling and testing are the most technically complex aspect of the household toxicant problem. They are concerned with the initial inherent safety of the toxic-containing products as they are marketed. How safe are these products? Who is evaluating the risk to the consumer from exposure? How can a discriminating householder know what he is buying? These are some of the questions that must be addressed.

The existing laws to control the labeling and testing of commercial products are covered in detail in the next subsection. Despite many legal constraints, the fact remains that, in the vast majority of cases, manufacturers are not required to test their products for safety before marketing. The Toxic Substance Control Act (TSCA) establishes a procedure whereby new chemicals proposed to be used in commercial products are tested, but provides a "blanket" acceptance for the hundreds of thousands of chemicals which were already on the market at the time its regulations went into effect (1979). Furthermore, the testing process itself has proved fallible: doubts have been raised as to the validity of test results for certain chemicals.

Tests that have been conducted on this limited number of chemicals have usually been for acute effects only. Although this is valuable information, it tells little or nothing about the possible risk of normal exposure to the average consumers: long-term, low level -- chronic -- exposures. Because the tests required to predict chronic effects are expensive and still in their infancy, they have rarely been completed. In short, most tests have looked at the easiest, but not necessarily the most important, testing parameters.

Some attempts have been made to control the marketing and use of a few select chemicals (again, please refer to the "Legal Frameworks," Section B); PCBs, for example, have been restricted for many uses, and carbon tetrachloride, once a common household cleaner, can no longer be sold in interstate commerce. Manufacturers often undertake pre-market testing on their products; according to CSMA (1982), "All household products are rigorously tested for safety of use and potential misuse."

The major controls on the retail end of consumer products entail labeling and child-proofing requirements -- the manufacturers must warn the consumer, in general terms, about the possibility of health risk (see Section B, which follows). Warnings are effective as long as people read the label and comprehend the meaning (N.B., most poisonings occur to children under five). It is doubtful that the average consumer recognizes the differences in hazard between the signal words "Danger," "Caution," or "Warning" used on all labels of hazardous products. Labeling requirements are obviously less effective at preventing harm than outright withdrawal of problem chemicals from the consumer market.

A major stumbling block to labeling as a means of providing the consumer with information is the doctrine of "trade secrets." Manufacturers are protected from disclosure of the contents of most products by various laws and judicial precedents, incorporated in the Freedom of Information Act, the Federal Trade Commission regulations, etc. Federal agencies have the power to gather certain information on chemicals (for example, the reporting requirements of the Toxic Substance Control Act), but in most cases trade secrecy blocks dissemination of ingredient information to state regulators or to the general public. From the industry point of view, of course, this secrecy is essential to product development, including "innovation in producing safer products for the public" (CSMA, 1982).

Without even the most rudimentary content information ("What's in this stuff?"), the concerned consumer has no basis for making buying decisions or determining his health risk. Many consumer products don't have to list any ingredients at all. For those products subject to regulations under the Federal Hazardous Substances Act, only the "hazardous' component must be identified on the label; concentrations of other components are rarely given. Only for pesticides are both the contents and concentrations required -- and then only the "active" ingredients. The other contents, which can themselves be very toxic (e.g., solvents), can be lumped under "inert" ingredients. Even when the hazardous or pesticidal ingredients are listed, manufacturers often use general names that are not clearly defined as specific compounds, (e.g., petroleum distillates). Different manufacturers will often call the same compound by different names and this lack of standardization can easily lead to confusion.

As can be gathered from the previous discussion, labeling and testing are complex and urgent issues with household toxicants. The solutions to the problems encountered, however, are possible primarily through legislation by the government (federal or state) or voluntary controls by the manufacturers; they are not issues over which the average consumer can have much control. Further information concerning labeling of household products can be found in Report B of this HHWD series (Toxicants in Consumer Products).

2. Safe Use

While labeling practices directly impinge on consumer choices of products and affect consumer decisions on disposal, the manner in which a product is used in most cases is not a major factor in its disposal. In general, the use of household products can be hazardous in one of three ways -- it can be acutely toxic to humans, e.g., lung damage from inhaling oven cleaner fumes; it can be a chronic health hazard to humans, e.g., exposure to vinyl chloride propellent, which is a known carcinogen (now banned); or, it can harm the environment in a multitude of ways, e.g., air pollution from solvent evaporation, water pollution from waste oil dumping, pollution of the soil through pesticide over-use, and so on.

It is well known that many household products do pose an acute health risk. The danger of poisoning has been publicized, and the vast majority of consumers are aware of it. What are less well known and publicized are the chronic health risks that the use of these products may incur. Is there a danger in repeated exposure to low level concentrations of these toxic substances? Researchers have found that only brief or infrequent exposures to a carcinogenic substance may be all that is needed to alter certain body cells irreversibly (Sasnett, 1979).

Householders, as well as industry, can in some cases use alternative chemicals and thereby circumvent the problems posed by the use of toxicant-containing products. Whenever feasible, we believe it is advisable to use such non-toxic alternatives. The definition of "feasibility," however, will vary enormously with people's attitudes: one person may be willing to buy an alternative, as long as it is as equally convenient, cheap, and effective as the original, more toxic product; others may be willing to go as far as formulating equivalent products at home, even if less convenient, more expensive, or slightly less effective.

3. Disposal

Is there a "problem" with the disposal of household hazardous waste? If so, what is the extent of the problem? As with many simple questions such as these, definitive answers are difficult or impossible to come by. Attempts to answer these questions center on two approaches: analysis of product contents and review of documented environmental effects.

(a) Product Content Approach. The existence and severity of a problem can be surmised or predicted by examining its potential sources. Do household products contain hazardous substances? Are they disposed of in environmentally harmful ways? Are the wastes disposed of in volumes large enough to make an impact? An evaluation of the hazards associated with product contents and their disposal follows, in Section C entitled "Contents of Products."

(b) Environmental Approach. Being able to document the effects of these products in the environment would be the most conclusive, but unfortunately the most difficult, way to assess the magnitude of the problem. To accurately determine an effect in the environment caused by use or disposal of these products, we would have to sample all residential waste streams and "sinks" (sewage, runoff, solid waste and groundwater). Lengthy and complex analytical methodology (both chemical and biological) would be necessary to determine if particular chemicals that are traceable back to a product source can be found in high concentrations and if such chemicals are having (or are capable of having) a deleterious biological effect, either acute or chronic. This is well beyond the resources of the HHWD project, but we examine the limited amount of available pertinent research in Section D entitled "Effects in the Environment."

B. LEGAL FRAMEWORK

Many laws and regulations exist which impinge on the use or disposal of products and/or their chemical constituents, from the federal Toxic Substance Control Act to the City of Seattle's

"Regulations for Removal of Garbage and Swill." An overview of the most pertinent of these laws is useful in order to see the regulatory framework within which product contents are developed, as well as the issues involved in the disposal of toxic or hazardous product wastes.

1. Federal Laws

Over twenty major federal laws affect toxic substance control in one way or another, from manufacturing, marketing, transportation, use, and exposure to disposal. Table 2 presents a brief overview of these acts, the federal agencies responsible for their administration, and the type of toxicant control each involves.

Each of these federal laws deals with one piece of the toxicant puzzle and has a different orientation to that puzzle. Definitions of "toxic" and "hazardous" and "poisonous" and "dangerous" differ; resulting criteria and lists of chemicals so identified differ. (See Appendix A for further details of this point.)

(a) Contents and Labeling of Household Products. Five of the federal laws mentioned in Table 2 directly impact the contents or labeling of products. These are reviewed below:

- The Federal Hazardous Substances Act. The FHSA establishes labeling requirements for household substances found to be "hazardous" and allows the Consumer Product Safety Commission to issue an outright ban of a substance or mixture which "possesses such a degree or nature of hazard that adequate cautionary labeling cannot be written and the public health and safety can be served only by keeping such articles out of interstate commerce."

  A "hazardous substance" under FHSA is one which is highly toxic, toxic, corrosive, an irritant, a strong sensitizer, extremely flammable, flammable, combustible, or capable of generating pressure, "if such substance...may cause substantial personal injury or substantial illness during...any customary or reasonably foreseeable handling or use."

  Products containing "hazardous substances" must bear a label of a specific size and containing certain information:

  -- a signal word: "DANGER" on those products that are extremely flammable, corrosive or highly toxic; and "WARNING" or "CAUTION" on all other hazardous substances required to bear a label;
  -- the additional word "POISON" and the skull and crossbones symbol for highly toxic substances and certain

Table 2. FEDERAL LAWS AND AGENCIES AFFECTING TOXIC SUBSTANCES CONTROL. (Council on Environmental Quality, 1978, with revisions).

Statute	Year Enacted	Responsible Agency	Sources covered
Toxic Substances Control Act	1976	EPA	Requires premarket evaluation of all new chemicals (other than food additives, drugs, pesticides, alcohol, tobacco); allows EPA to regulate existing chemical hazards not covered by other laws related to toxic substances.
Clean Air Act	1970, amended 1977	EPA	Hazardous air pollutants
Federal Water Pollution Control Act	1972, amended 1977	EPA	Toxic water pollutants
Safe Drinking Water Act	1974, amended 1977	EPA	Drinking water contaminants
Federal Insecticide, Fungicide and Rodenticide Act	1948, amended 1972, 1975, 1978, 1980	EPA	Pesticides
Act of July 22, 1954 (codified as 346(a) of the Food, Drug and Cosmetic Act)	1954, amended 1972	EPA	Tolerances for pesticide residues in food
Resource Conservation and Recovery Act	1976, amended 1980	EPA	Hazardous wastes
Marine Protection, Research and Sanctuaries Act	1972	EPA	Ocean dumping
Comprehensive Environmental Response, Compensation, and Liability Act- "Superfund"	1980	EPA	Clean-up of hazardous waste sites
Food, Drug and Cosmetic Act	1938	FDA	Basic coverage of food, drugs, and cosmetics
Food additives amendment	1958	FDA	Food additives
Color additive amendments	1960	FDA	Color additives
New drug amendments	1962	FDA	Drugs
New animal drug amendments	1968	FDA	Animal drugs and feed additives
Medical device amendments	1976	FDA	Medical devices

Table 2. FEDERAL LAWS AND AGENCIES AFFECTING TOXIC SUBSTANCES CONTROL. (Council on Environmental Quality, 1978, with revisions).

(Continued)

Statute	Year Enacted	Responsible Agency	Sources covered
Wholesome Meat Act	1967	USDA	Food, feed, and color additives and pesticide residues in meat and poultry
Wholesome Poultry Products Act	1968	USDA	
Occupational Safety and Health Act	1970	OSHA	Workplace toxic chemicals
Federal Hazardous Substances Act	1966, amended 1981	CPSC	"Toxic" household products (equivalent to consumer products).
Consumer Product Safety Act	1972, amended 1981	CPSC	Dangerous consumer products
Poison Prevention Packaging Act	1970, amended 1981	CPSC	Packaging of products that could lead to poisoning of children
Lead Based Paint Poison Prevention Act	1971, amended 1979	CPSC	Use of lead paint in federally-assisted housing
Hazardous Materials Transportation Act	1970	DOT, (Materials Transportation Bureau)	Transportation of toxic substances generally
Federal Railroad Safety Act	1970	DOT (Federal Railroad Administration)	Railroad safety
Ports and Waterways Safety Act	1972	DOT (Coast Guard)	Shipment of toxic materials by water
Dangerous Cargo Act	1952	DOT (Coast Guard)	Shipment of toxic materials by water

CPSC=Consumer Product Safety Commission
DOT=U.S. Department of Transportation
EPA=U.S. Environmental Protection Agency
FDA=Food and Drug Administration
OSHA=Occupational Safety and Health Administration
USDA=U.S.Department of Agriculture

other substances specifically named under the regulations;

- a description of the principal hazards involved in using the product, such as "Vapor Harmful," "Flammable," and the like;
- a statement of measures the user should take to avoid the hazard, such as "Use Only in a Well-Ventilated Area";
- a list of the common names of the hazardous ingredients; if a hazardous substance has no common name, the chemical name will be used;
- if necessary, instructions for safe handling and storage;
- first aid instructions;
- name and location of the manufacturer, distributor or repacker;
- the statement "Keep Out of Reach of Children" or its equivalent; and
- any additional information that the Commission finds necessary to protect the public health.

Items banned by the CPSC for sale as or in household products include:

- extremely flammable water repellents;
- carbon tetrachloride;
- certain loud fireworks;
- liquid drain cleaners containing 10% or more potassium hydroxide;
- products containing soluble cyanide salts;
- paint with lead content above 0.06% dry weight (except artist's paint);
- general use garments, tape joint compounds and artificial fireplace embers containing asbestos; and
- aerosols containing vinyl chloride monomer.

Other substances under review by the CPSC for possible or additional regulations include:

- asbestos in other products;
- benzene;
- formaldehyde;
- benzedine dyes;
- chemical room deodorizers;
- carbon monoxide;
- chlorofluorocarbons;
- hydrocarbon aerosol propellants;
- lead;
- hexane; and
- assorted artisan products (containing pigments, solvents, lead and other heavy metals).

- The Consumer Product Safety Act. The CPSA establishes the Consumer Product Safety Commission and empowers the CPSC to "protect the public against unreasonable risks of injury" associated with consumer products. This authority includes the development of safety standards for performance, composition, contents, design, construction, finish or packaging, the requirement for clear and adequate warnings to be marked on products, and the banning of products for which safety standards would not adequately protect the public.

  Although the CPSA gives the Commission the authority to regulate toxic or hazardous products under this law rather than the FHSA if it is "in the public interest" to do so, in practice the FHSA takes precedence and, to date, all regulations controlling product content or labeling have been promulgated under FHSA.

- The Federal Food, Drug and Cosmetic Act. The FFDCA directs the Food and Drug Administration to ensure that foods are safe to eat, that drugs are safe and effective, and that packaging and labeling of foods and drugs are truthful and informative. Sections which directly affect toxicants include:

  -- setting of tolerances for poisonous substances in food,
  -- assessing the safety of food additives, and
  -- prohibiting the addition to food of any substance found to induce cancer in man or animals (the "Delaney Clause").

  Any food may be deemed "adulterated" if it contains or has added to it "any poisonous or deleterious substance which may render it injurious to health." The FDA monitors and assesses the health risk of all types of chemical contaminants.

- The Federal Insecticide, Fungicide and Rodenticide Act. FIFRA regulates the manufacture, use and disposal of "economic poisons" for agricultural, forestry, household and other activities. It requires registration of all pesticides, classifies pesticides for general (e.g., household) versus restricted use, requires "informative and accurate labeling," and provides for suspension or cancellation of registrations for "imminent hazard" or "unreasonable adverse effects on the environment."

  "Pesticide" under FIFRA includes "any substance or mixture of substance intended for preventing, destroying, repelling, or mitigating" insects, rodents, fungi, weeds, and other forms of plant and animal life which are "injurious to health or the environment." "Other forms" include bacteria and viruses, except within man and animals (poisons that affect internal pests are called "drugs"); thus disinfectants are pesticides and require registration under FIFRA.

A pesticide must be registered by EPA to be sold. All pesticides on the market at the enactment of FIFRA were given a blanket ("grandfather") registration; review of these thousands of chemicals is a slow process. It is important to recognize, therefore, that EPA registration of a pesticide does not imply safety. About 30 substances have had registration cancelled, or most registered uses suspended; these include (among others) the following pesticides:

- Aldrin
- BHC (non-gamma)
- Chlordane
- DBCP
- DDD
- DDT
- Dieldrin
- Endrin[1]
- Heptachlor
- Kepone
- Mirex
- Safrole
- Sodium Cyanide
- Strobane
- Strychnine
- 2,4,5-T/Silvex[1]
- Thallium Sulfate
- Toxaphene[1]

A number of other pesticides are under federal review for possible de-registration at this time because of some significant questions about their injuriousness to health or the environment. This review process is called "RPAR:" Rebuttable Presumption Against Registration.

Classification of a registered pesticide into general use or restricted use categories is based on a determination of whether or not the pesticide, "when applied in accordance with its directions for use, warnings and cautions..., may generally cause unreasonable adverse effects on the environment, including injury to the applicator." Table 3 contains a list of those pesticides which have been classified for restricted use; they may only be used by a certified applicator.

All pesticide containers must be labeled with the following information "prominently placed with such conspicuousness...and in such terms as to render it likely to be read and understood by the ordinary individual:"

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[1] Not all uses are suspended.

Table 3. RESTRICTED USE PESTICIDES.[1]
(40. Code of Federal Regulations 162.31.)

Acrolein
Acrylonitrile
Aldicarb
Allyl alcohol
Aluminum phosphide
Azinophos methyl
Calcium cyanide
Carbofuran
Chlorfenvinphos
Chloropicrin
Clonitralid
Cycloheximide
Demeton
Dicrotophos
Dioxathion
Disulfoton

Endrin
EPN
Ethoprop
Ethyl parathion
Fenamiphos
Fensulfothion
Fluoroacetamide/1081
Fonofos
Hydrocyanic acid
Methamidophos
Methidathion
Methomyl
Methyl bromide
Methyl parathion

Mevinphos
Monocrotophos
Nicotine (alkaloid)
Paraquat (dichloride) and paraquat bis(methyl sulfate)
Phorate
Phosacetim
Phosphamidon
Picloram
Sodium cyanide[1]
Sodium fluoroacetate
Strychnine
Sulfotepp
Tepp
Zinc Phosphide

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[1] Pesticide products containing any of these substances as the active ingredients are not to be used by the homeowner; they can be used only by a certified applicator.

- the name, brand or trademark;
- directions for use which are
  - "necessary for effecting the purpose for which the product is intended;" and
  - adequate if complied with "to protect health and the environment;"
- an ingredient statement, giving the name and percentage of each active ingredient and the percentage of all inert ingredients;
- a statement of the use classification under which it is registered;
- the name and address of the producer;
- warning or caution statements, as follows:
  - human hazard "signal" word -- based on the toxicity chart shown in Table 4, certain signal words must be placed prominently on the front label: "DANGER" for Toxicity Category 1 (plus "POISON" and skull and crossbones if category 1 is assigned on the basis of oral, inhalation or dermal); "WARNING" for TC2; "CAUTION" for TC3 and 4;
  - child hazard warning -- every pesticide must bear the statement "Keep Out of Reach of Children" on the front label; and
  - precautionary statements -- where human hazards exist, statements such as shown in Table 5 must be placed on label; where acute LD$_{50}$[1] is 100 or less for mammalian oral or fish, the statement "This pesticide is Toxic to Wildlife (or Fish)" is required on the label.

Special packaging is required for some pesticides used in "residential application" that is "significantly difficult for children under five years of age to open or obtain a toxic or harmful amount...within a reasonable time, and that is not difficult for normal adults to use properly." The criteria for requiring special packaging include:

- acute dermal LD$_{50}$ of 2000 mg/kg or less;
- inhalation LC$_{50}$ of 2 mg/l or less;
- corrosive to the eye or skin; and
- acute oral LD$_{50}$ of 1.5 g/kg or less.

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[1] Toxicity measurements are explained in Appendix A.

Table 4. TOXICITY CATEGORIES FOR WARNING LABELS ON PESTICIDE CONTAINERS. (40 CFR 162.10.)

Hazard indicators	Toxicity categories			
	I	II	III	IV
Oral LD_{50}	Up to and including 50 mg/kg.	From 50 thru 500 mg/kg	From 500 thru 5000 mg/kg.	Greater than 5000 mg/kg.
Inhalation LC_{50}	Up to and including .2 mg/liter.	From .2 thru 2 mg/liter	From 2. thru 20 mg/liter	Greater than 20 mg/liter.
Dermal LD_{50}	Up to and including 200 mg/kg.	From 200 thru 2000	From 2,000 thru 20,000	Greater than 20,000.
Eye effects	Corrosive; corneal opacity not reversible within 7 days.	Corneal opacity reversible within 7 days; irritation persisting for 7 days.	No corneal opacity; irritation reversible within 7 days.	No irritation.
Skin effects	Corrosive	Severe irritation at 72 hours.	Moderate irritation at 72 hours.	Mild or slight irritation at 72 hours.

Table 5. EXAMPLE PRECAUTIONARY STATEMENTS FOR LABELS ON PESTICIDE CONTAINERS. (40 CFR 162.10.)

Toxicity category	Precautionary statements by toxicity category	
	Oral, inhalation, or dermal toxicity	Skin and eye local effects
I	Fatal (poisonous) if swallowed [inhaled or absorbed through skin]. Do not breathe vapor [dust or spray mist]. Do not get in eyes, on skin, or on clothing. [Front panel statement of practical treatment required.]	Corrosive, causes eye and skin damage [or skin irritation]. Do not get in eyes, on skin, or on clothing. Wear goggles or face shield and rubber gloves when handling. Harmful or fatal if swallowed. [Appropriate first aid statement required.]
II	May be fatal if swallowed [inhaled or absorbed through the skin]. Do not breathe vapors [dust or spray mist]. Do not get in eyes, on skin, or on clothing. [Appropriate first aid statements required.].	Causes eye [and skin] irritation. Do not get in eyes, on skin, or on clothing. Harmful if swallowed. [Appropriate first aid statement required.]
III	Harmful if swallowed [inhaled or absorbed through the skin]. Avoid breathing vapors [dust or spray mist]. Avoid contact with skin [eyes or clothing]. [Appropriate first aid statement required.].	Avoid contact with skin, eyes or clothing. In case of contact immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.
IV	[No precautionary statements required.]	[No precautionary statements required.]

- The Toxic Substance Control Act. TSCA authorizes EPA to obtain production and test data from industry on all commercial chemicals except pesticides and drugs, and to regulate manufacture, processing, distribution, use or disposal of chemicals "which present an unreasonable risk of injury to health or to the environment." This comprehensive program includes:

  -- testing, registration, and, if necessary, limitation or prohibitions on manufacture and use of new chemicals; and
  -- inventory, testing and reevaluation of existing chemicals for use-registration.

  Four substances have been banned or severely restricted in use under TSCA:

  -- polychlorinated biphenyls (PCBs);
  -- chlorofluorocarbons (CFCs) in aerosols;
  -- 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD); and
  -- asbestos in numerous materials.

(b) Disposal of Toxic or Hazardous Substances. Three federal laws that deal with disposal of toxic substances have some direct effect on household wastes. These are reviewed below:

- The Resource Conservation and Recovery Act. RCRA establishes a "cradle to grave" regulatory program for management of hazardous wastes (as distinct from TSCA, which covers hazardous substances before they become "wastes"). The regulations cover identification of hazardous wastes as well as standards for generation (containerization, labeling, reporting), transport, storage and disposal (locating, design, permitting) of such wastes.

  RCRA identifies characteristics and a list of those solid wastes that are considered hazardous. The four characteristics are: ignitability, corrosivity, reactivity and toxicity. Two lists have been developed: 100 process wastes from specific industries, and 416 specific chemicals. A solid waste is a hazardous waste if: 1) it exhibits any of the specified characteristics, or 2) it is listed.

  The specific chemical lists are divided into two groups, the really nasty "acute hazardous wastes," and the less nasty "toxic wastes." The acute hazardous wastes (see Table 6) are subject to the full RCRA regulations in very small quantities: the chemical product in quantities greater than one kilogram (2.2 pounds); any containers used to hold a listed product greater than 20 liters in size; any container liners in contact with a listed product in quantities greater than 10 kilograms; or any spill residues or contaminated soil in

Table 6. RCRA ACUTE HAZARDOUS WASTES.

Hazardous waste No.	Substance
	1080 see P058
	1081 see P057
	(Acetato)phenylmercury see P092
	Acetone cyanohydrin see P069
P001	3-(alpha-Acetonylbenzyl)-4-hydroxycoumarin and salts
P002	1-Acetyl-2-thiourea
P003	Acrolein
	Agarin see P007
	Agrosan GN 5 see P092
	Aldicarb see P069
	Aldifen see P048
P004	Aldrin
	Algimycin see P092
P005	Allyl alcohol
P006	Aluminum phosphide (R)
	ALVIT see P037
	Aminoethylene see P054
P007	5-(Aminomethyl)-3-isoxazolol
P008	4-Aminopyridine
	Ammonium metavanadate see P119
P009	Ammonium picrate (R)
	ANTIMUCIN WDR see P092
	ANTURAT see P073
	AQUATHOL see P088
	ARETIT see P020
P010	Arsenic acid
P011	Arsenic pentoxide
P012	Arsenic trioxide
	Athrombin see P001
	AVITROL see P008
	Aziridene see P054
	AZOFOS see P061
	Azophos see P061
	BANTU see P072
P013	Barium cyanide
	BASENITE see P020
	BCME see P016
P014	Benzenethiol
	Benzoepin see P050
P015	Beryllium dust
P016	Bis(chloromethyl) ether
	BLADAN-M see P071
P017	Bromoacetone
P018	Brucine
P019	2-Butanone peroxide
	BUFEN see P092
	Butaphene see P020
P020	2-sec-Butyl-[illegible]6-dinitrophenol
P021	Calcium cyanide
	CALDON see P020
P022	Carbon disulfide
	CERESAN see P092
	CERESAN UNIVERSAL see P092
	CHEMOX GENERAL see P020
	CHEMOX P.E. see P020
	CHEM-TOL see P090
P023	Chloroacetaldehyde
P024	p-Chloroaniline
P025	1-(p-Chlorobenzoyl)-5-methoxy-2-methylindole-3-acetic acid
P026	1-(o-Chlorophenyl)thiourea
P027	3-Chloropropionitrile
P028	alpha-Chlorotoluene
P029	Copper cyanide
	CRETOX see P108
	Coumadin see P001
	Coumafen see P001
P030	Cyanides
P031	Cyanogen
P032	Cyanogen bromide
P033	Cyanogen chloride
	Cyclodan see P050
P034	2-Cyclohexyl-4,6-dinitrophenol
	D-CON see P001
	DETHMOR see P001
	DETHNEL see P001
	DFP see P043
P035	2,4-Dichlorophenoxyacetic acid (2,4-D)
P036	Dichlorophenylarsine
	Dicyanogen see P031
P037	Dieldrin
	DIELDREX see P037
P038	Diethylarsine
P039	O,O-Diethyl-S-(2-(ethylthio)ethyl)ester of phosphorothioic acid
P040	O,O-Diethyl-O-(2-pyrazinyl)phosphorothioate
P041	O,O-Diethyl phosphoric acid, O-p-nitrophenyl ester
P042	3,4-Dihydroxy-alpha-(methylamino)-methyl benzyl alcohol
P043	Di-isopropylfluorophosphate
	DIMETATE see P044
	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro endo, endo see P060
P044	Dimethoate
P045	3,3-Dimethyl-1-(methylthio)-2-butanone-O-((methylamino)carbonyl) oxime
P046	alpha,alpha-Dimethylphenethylamine
	Dinitrocyclohexylphenol see P034
P047	4,6-Dinitro-o-cresol and salts
P048	2,4-Dinitrophenol
	DINOSEB see P020
	DINOSEBE see P020
	Disulfoton see P039
P049	2,4-Dithiobiuret
	DNBP see P020
	DOLCO MOUSE CEREAL see P108
	DOW GENERAL see P020
	DOW GENERAL WEED KILLER see P020
	DOW SELECTIVE WEED KILLER see P020
	DOWICIDE G see P090
	DYANACIDE see P092
	EASTERN STATES DUOCIDE see P001
	ELGETOL see P020
P050	Endosulfan
P051	Endrin
	Epinephrine see P042
P052	Ethylcyanide
P053	Ethylenediamine
P054	Ethyleneimine
	FASCO FASCRAT POWDER see P001
	FEMMA see P091
P055	Ferric cyanide
P056	Fluorine
P057	2-Fluoroacetamide
P058	Fluoroacetic acid, sodium salt
	FOLODOL-80 see P071
	FOLODOL M see P071
	FOSFERNO M 50 see P071
	FRATOL see P058
	Fulminate of mercury see P065
	FUNGITOX OR see P092
	FUSSOF see P057
	GALLOTOX see P092
	GEARPHOS see P071
	GERUTOX see P020
P059	Heptachlor
P060	1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-endo, endo-dimethanonaphthalene
	1,4,5,6,7,7-Hexachloro-cyclic-5-norbornene-2,3-dimethanol sulfite see P050
P061	Hexachloropropene
P062	Hexaethyl tetraphosphate
	HOSTAQUICK see P092
	HOSTAQUIK see P092
	Hydrazomethane see P068
P063	Hydrocyanic acid
	ILLOXOL see P037
	INDOCI see P025
	Indomethacin see P025
	INSECTOPHENE see P050
	Isodrin see P060
P064	Isocyanic acid, methyl ester
	KILOSEB see P020
	KOP-THIODAN see P050
	KWIK-KIL see P108
	KWIKSAN see P092
	KUMADER see P001
	KYPFARIN see P001
	LEYTOSAN see P092
	LIQUIPHENE see P092

Table 6. RCRA ACUTE HAZARDOUS WASTES (continued)

Hazardous waste No.	Substance
	MALIK see P050
	MAREVAN see P001
	MAR-FRIN see P001
	MARTIN'D MAR-FRIN see P001
	MAVERAN see P001
	MEGATOX see P005
P065	Mercury fulminate
	MERSOLITE see P092
	METACID 50 see P071
	METAFOS see P071
	METAPHOR see P071
	METAPHOS see P071
	METASOL 30 see P092
P066	Methomyl
P067	2-Methylaziridine
	METHYL-E 605 see P071
P068	Methyl hydrazine
	Methyl isocyanate see P064
P069	2-Methyllactonitrile
P070	2-Methyl-2-(methylthio)propionaldehyde-o-(methylcarbonyl) oxime
	METHYL NIRON see P042
P071	Methyl parathion
	METRON see P071
	MOLE DEATH see P108
	MOUSE-NOTS see P108
	MOUSE-RID see P108
	MOUSE-TOX see P108
	MUSCIMOL see P007
P072	1-Naphthyl-2-thiourea
P073	Nickel carbonyl
P074	Nickel cyanide
P075	Nicotine and salts
P076	Nitric oxide
P077	p-Nitroaniline
P078	Nitrogen dioxide
P079	Nitrogen peroxide
P080	Nitrogen tetroxide
P081	Nitroglycerine (R)
P082	N-Nitrosodimethylamine
P083	N-Nitrosodiphenylamine
P084	N-Nitrosomethylvinylamine
	NYLMERATE see P092
	OCTALOX see P037
P085	Octamethylpyrophosphoramide
	OCTAN see P092
P086	Oleyl alcohol condensed with 2 moles ethylene oxide
	OMPA see P085
	OMPACIDE see P085
	OMPAX see P085
P087	Osmium tetroxide
P088	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
	PANIVARFIN see P001
	PANORAM D-31 see P037
	PANTHERINE see P007
	PANWARFIN see P001
P089	Parathion
	PCP see P090
	PENNCAP-M see P071
	PENOXYL CARBON N see P048
P090	Pentachlorophenol
	Pentachlorophenate see P090
	PENTA-KILL see P090
	PENTASOL see P090
	PENWAR see P090
	PERMICIDE see P090
	PERMAGUARD see P090
	PERMATOX see P090
	PERMITE see P090
	PERTOX see P090
	PESTOX III see P085
	PHENMAD see P092
	PHENOTAN see P020
P091	Phenyl dichloroarsine
	Phenyl mercaptan see P014
P092	Phenylmercury acetate
P093	N-Phenylthiourea
	PHILIPS 1861 see P008
	PHIX see P092
P094	Phorate
P095	Phosgene
P096	Phosphine
P097	Phosphorothioic acid, 0,0-dimethyl ester, 0-ester with N,N-dimethyl benzene sulfonamide
	Phosphorothioic acid 0,0-dimethyl-0-(p-nitrophenyl) ester see P071
	PIED PIPER MOUSE SEED see P108
P098	Potassium cyanide
P099	Potassium silver cyanide
	PREMERGE see P020
P100	1,2-Propanedial
	Propargyl alcohol see P102
P101	Propionitrile
P102	2-Propyn-1-ol
	PROTHROMADIN See P001
	QUICKSAM see P092
	QUINTOX see P037
	RAT AND MICE BAIT see P001
	RAT-A-WAY see P001
	RAT-B-GON see P001
	RAT-O-CIDE #2 see P001
	RAT-GUARD see P001
	RAT-KILL see P001
	RAT-MIX see P001
	RATS-NO-MORE see P001
	RAT-OLA see P001
	RATOREX see P001
	RATTUNAL see P001
	RAT-TROL see P001
	RO-DETH see P001
	RO-DEX see P108
	ROSEX see P001
	ROUGH & READY MOUSE MIX see P001
	SANASEED see P108
	SANTOBRITE see P090
	SANTOPHEN see P090
	SANTOPHEN 20 see P090
	SCHRADAN see P085
P103	Selenourea
P104	Silver Cyanide
	SMITE see P105
	SPARIC see P020
	SPOR-KIL see P092
	SPRAY-TROL BRAND RODEN-TROL see P001
	SPURGE see P020
P105	Sodium azide
	Sodium coumadin see P001
P106	Sodium cyanide
	Sodium fluoroacetate see P056
	SODIUM WARFARIN see P001
	SOLFARIN see P001
	SOLFOBLACK BB see P048
	SOLFOBLACK SB see P048
P107	Strontium sulfide
P108	Strychnine and salts
	SUBTEX see P020
	SYSTAM see P085
	TAG FUNGICIDE see P092
	TEKWAISA see P071
	TEMIC see P070
	TEMIK see P070
	TERM-I-TROL see P090
P109	Tetraethyldithiopyrophosphate
P110	Tetraethyl lead
P111	Tetraethylpyrophosphate
P112	Tetranitromethane
	Tetraphosphoric acid, hexaethyl ester see P062
	TETROSULFUR BLACK PB see P048
	TETROSULPHUR PBR see P048
P113	Thallic oxide
	Thallium peroxide see P113
P114	Thallium selenite
P115	Thallium (I) sulfate
	THIFOR see P092
	THIMUL see P092
	THIODAN see P050
	THIOFOR see P050
	THIOMUL see P050
	THIONEX see P050
	THIOPHENIT see P071
P116	Thiosemicarbazide
	Thiosulfan tionel see P050
P117	Thiuram
	THOMPSON'S WOOD FIX see P090
	TIOVEL see P050
P118	Trichloromethanethiol
	TWIN LIGHT RAT AWAY see P001
	USAF RH-8 see P069
	USAF EK-4890 see P002
P119	Vanadic acid, ammonium salt
P120	Vanadium pentoxide
	VOFATOX see P071
	WANADU see P120
	WARCOUMIN see P001
	WARFARIN SODIUM see P001
	WARFICIDE see P001
	WOFOTOX see P072
	YANOCK see P057
	YASOKNOCK see P058
	ZIARNIK see P092
P121	Zinc cyanide
P122	Zinc phosphide (R,T)
	ZOOCOUMARIN see P001

[1] The Agency included those trade names of which it was aware; an omission of a trade name does not imply that the omitted material is not hazardous. The material is hazardous if it is listed under its generic name.

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quantities greater than 100 kilograms. The toxic wastes are subject to the RCRA regulations only in quantities greater than 1,000 kilograms (2,200 pounds) per month or more than 1,000 kilograms at any one time.

A few specific types of wastes are exempt from RCRA, including household waste, which is defined as "any waste material (including garbage, trash and sanitary wastes in septic tanks) derived from households (including single and multiple residences, hotels, and motels)."

Although household wastes are technically exempt from RCRA regulation, the substances listed in Table 6 are illustrative of products or contents of products for which extreme care should be exercised in their use and disposal.

- The Federal Insecticide, Fungicide and Rodenticide Act. Section 19 of FIFRA establishes regulations for the storage and disposal of excess amounts of pesticides and their empty containers. It requires EPA to accept "at convenient locations for safe disposal" any cancelled or banned pesticide, "if requested by the owner of the pesticide." According to the regulations, the owner must first "make every reasonable effort to return the material to either its manufacturer, distributor, or to another agent capable of using the material," including export to a country where use of the pesticide is still legal!

  The regulations state clearly the exemption of household products: "Recommended pesticide and pesticide container disposal procedures shall not apply to containers of pesticides registered for use in the home and garden if securely wrapped in several layers of paper and disposed of singly during routine municipal solid waste disposal" (40 CFR 165.2 (e)). The introduction to the regulations indicates "Such disposal will have only minimal environmental impact and is preferable to concentrating these products and containers."

  The Section 19 regulations do give some recommended storage and disposal procedures for classes of pesticides: organic, metal-organic and inorganic. The EPA publication, Guidelines for the Disposal of Small Quantities of Unused Pesticides (Lawless et al., 1975), provides much more specific information, but without the force of law.

- The Clean Water Act. Pollutant discharges to water are controlled under the CWA, whether from industrial or publicly-owned sewage treatment plants ("point sources") or from run-off or spills ("non-point sources"). Section 307 (a) establishes a list of toxic or "priority" pollutants which are of special water quality concern. The current priority pollutant list contains 126 substances: thirteen heavy metals, cyanide and asbestos, and 111 organic chemicals. Water quality criteria are being developed for each of these substances and discharge levels for point sources will be promulgated, including "pretreatment" standards for industries tributary to public treatment systems.

Section 311 of CWA regulates spills or "incident" discharges of oil and "hazardous substances" into or upon navigable waters. For oil, a reportable quantity "which may be harmful," based on acute toxicity to aquatic organisms, is any amount that will:

> ...cause a film or sheen upon discoloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines (40 CFR 110.3 (b)).

This includes not only direct discharges to water bodies but also indirect discharges such as into storm drains or sewers which have the potential to enter navigable waters. The U.S. Coast Guard has jurisdiction over Section 311 spills in marine waters, while the U.S. EPA and Washington State DOE have jurisdiction in fresh waters; in practice, all three agencies receive notification of all spills and respond according to resources and priorities.

2. Washington State Laws

The Revised Code of Washington ("RCW") contains a number of state laws which concern toxic substances in products or wastes. Most do so only marginally and in general are not as inclusive as the federal laws that, in many cases, they are meant to incorporate at the state level. The two major exceptions (i.e., the two areas where state law significantly impinge on toxicants compared to federal statutes) are the areas of pesticides and hazardous wastes.

Regulations implementing the RCWs are found in the Washington Administrative Code ("WAC"). These are referred to in the following discussion where appropriate.

(a) Product Content, Labeling and Sales. Human poisons and pesticides are the two categories of products regulated under state law:

- Poisons. The Washington Caustic Poison Act of 1929 (RCW 69.36) requires containers of "dangerous caustic or corrosive substances" to bear labels with the word POISON "running parallel with the main body or reading matter in a clear, plain background of a distinctly contrasting color in uncondensed gothic capital letters not less than 24 point type." The substances so labeled are:

- -- hydrochloric acid (greater than or equal to 10%),
- -- nitric acid (greater than or equal to 5%),
- -- phenol (carbolic acid) (greater than or equal to 5%),
- -- oxalic acid (greater than or equal to 10%),
- -- acetic acid (greater than or equal to 20%)
- -- hypochlorous acid,
- -- potassium hydroxide (greater than or equal to 10%),
- -- sodium hydroxide (greater than or equal to 10%),
- -- silver nitrate (greater than or equal to 5%), and
- -- ammonia water (greater than or equal to 5%).

Under the Poisons and Dangerous Drugs Section (RCW 69.40), it is unlawful to put out crackers, biscuits or bread containing arsenic or strychnine, to sell any milk or food products containing formaldehyde, or to sell any of the following substances without a label marked POISON:

- -- arsenic,
- -- cyanide of potassium,
- -- hydrocyanic acid,
- -- strychnine,
- -- arsenical solutions,
- -- carbolic acid (phenol),
- -- chloroform,
- -- creosote,
- -- oxalic acid,
- -- salts of lead,
- -- salts of zinc, or
- -- any chemical which "is liable to be destructive to adult human life in quantities of 60 grains or less."

The Washington Poison Prevention Act of 1974 (RCW 70.106) requires special "child-proof" packaging for a number of products, equivalent to the federal Poison Prevention Packaging Act.

- Pesticides. The Washington Pesticide Control Act (RCW 15.58) contains many provisions identical to and/or implementing FIFRA. It defines a "state restricted use pesticide" as:

> any pesticide or device which the Director has found and determined...to be so injurious to persons, pollinating insects, bees, animals, crops, wildlife, or lands other than the pests it is intended to prevent, destroy, control, or mitigate that additional restrictions are required,

and requires adoption of a list of such restricted use pesticides.

The Washington Pesticide Application Act (RCW 17.21) requires that "all restricted use pesticides shall be purchased, possessed, or used" only with a permit and by a licensed applicator or seller; i.e., "shall not be sold to home and garden users." The list of restricted use pesticides is found in WAC 16-228-155 and is presented in Table 7. Forty-five substances are so listed at this time. This list and the list of restricted pesticides under FIFRA (Table 3) have some overlap, but are not identical.

Under WAC 16-228-225, all rodenticide baits are divided into three classes, which must be labeled as follows:

- WARNING -- RODENT BAIT: warfarin, pindone (Pival), diphacinone (Diphacin), coumafuryl (Fumarin), chlorophacinone (Rozol), and other anticoagulants;
- WARNING -- RODENT BAIT -- POISON: zinc phosphide, arsenic, Red Squill, strychnine, alpha-naphthylthiourea (Antu), Vacor (DLP-787), and barium carbonate;
- WARNING -- RODENT BAIT -- FATAL POISON: sodium fluoroacetate (1080), fluoroacetamide (1081), and phosphorus paste.

Under RCW 16.52.193, it is unlawful for any person other than a registered pharmacist to sell strychnine.

(b) Disposal. The Solid Waste Management Code (RCW 70.95) provides minimum state standards and encourages planning, but assigns primary responsibility for solid waste management to local governments. Section 240 states that it is unlawful to "dump or deposit any solid waste onto or under the surface of the ground or into waters of the state except at a solid waste disposal site for which there is a valid permit: provided, that nothing herein shall prohibit a person from dumping or depositing solid waste resulting from his own activities onto or under the surface of ground owned or leased by him which such action does not violate statutes or ordinances, or create a nuisance."

The pesticide regulations (WAC 16-288-185) state, "No person shall transport, handle, store, load, apply, or dispose of any pesticide, container or apparatus in a manner that will pollute water supplies or waterways, or cause damage or injury to land, including humans, desirable plant and animals, pollinating insects, or wildlife: provided,...that disposing of pesticides at disposal sites approved by the local health department complies with the requirements of this subsection."

Table 7. WASHINGTON STATE RESTRICTED USE PESTICIDES.

WAC 16-228-155. Restricted use pesticides--Not for use by home and garden users. (1) The following pesticides are hereby declared to be restricted use pesticides in the state of Washington because of their toxicity to man and animals and shall not be sold to home and garden users. The following pesticides will be registered only when manufactured, labeled, delivered, distributed, sold, or held for sale for use by commercial producers and/or commercial applicators or governmental agencies experienced in the application of pesticides.

1. Aluminum Phosphide (Phostoxin)
2. Arsenic Trioxide (1.6% and above except for the control or eradication of crabgrass and the container thereof is restrictively labeled for such.
3. Azodrin
4. Bidrin
5. Castrix
6. Dasanit
7. Delnav (25.1% and above)
8. DiNitro-O-Cresol (DNOC)
9. DiNitro-O-Sec Butyl Phenol (DNOSBP)
10. DiSyston (2.1% and above)
11. Dyfonate (11% and above)
12. Endothall (20% and above)
13. Endrin (2.5% and above)
14. EPN
15. Ethion (26% and above)
16. Furadan (Carbofuran)
17. Guthion (16% and above)
18. Hydrogen Cyanide (Hydrocyanic acid) (HCN)
19. Methomyl(Lannate or Nudrin) (2% and above)
20. Methyl Bromide
21. Methyl Demeton
22. Methyl Parathion
23. Monitor (40% and above)
24. OMPA (Schradan)
25. Paraquat (cation equivalent-.5% and above)
26. Parathion
27. Phosdrin
28. Phosphamidon
29. Phosphorus paste (further restricted in WAC 16-228-145)
30. PMA - Phenyl Mercuric Acetate (1.5% and above)
31. Sodium Arsenite
32. Sodium Selanate
33. Strychnine and its salts (Strychnine Alkaloid 1.1% and above)
34. Systox (Demeton)
35. Temik
36. 1080 and 1081 (further restricted in WAC 16-228-145)
37. TEPP
38. Thallium compounds (banned for all rodenticide uses)
39. Thimet
40. Trithion (liquid and wettable powder 26% and above; granular and dust 11% and above)
41. Zinc Phosphide (2.1% and above)
42. Zinophos
43. Lindane
44. DDD
45. DDT

The Water Pollution Control Code (RCW 90.48) regulates discharges of pollutants into state waters through permits, state water quality standards, etc. Section 080 states, "It shall be unlawful for any person to throw, drain, run, or otherwise discharge into any of the waters of this state...any organic or inorganic matter that shall cause or tend to cause pollution..." Section 320 states specifically, "It is unlawful for oil to enter the waters of the state..." No state water quality standards have been issued for the Clean Water Act priority pollutants.

The Model Litter Control and Recycling Act (RCW 70-93) gives the state Department of Ecology authority to "foster private recycling" and "increase public awareness of the need for recycling" as well as litter control. Such recycling includes used automotive oil.

And finally, but not leastly, the Washington Hazardous Waste Disposal Act (RCW 70.105) and implementing regulations (WAC 173-303) control the handling and disposal of solid wastes which are "dangerous or extremely hazardous to the public health and environment." The HWDA is the state equivalent of the federal RCRA and is similar and compatible in most respects; however, some significant differences exist. The most notable difference is that the state regulations identify a two-tier, dangerous versus extremely hazardous, designation of wastes, plus a "degree of risk" assessment based on quantities and concentrations. Also, exempt quantities for dangerous wastes are smaller than the federal amounts.

Dangerous waste is defined as any waste or containers of such waste "...which are disposed of in such quantity or concentration as to pose a substantial present or potential hazard to human health, wildlife, or the environment..." Extremely hazardous waste is that dangerous waste which a) is persistent, will bioconcentrate or cause mutations, and "...is highly toxic to man or wildlife," and b) "...is disposed of...in such quantities as would present an extreme hazard to man or the environment."

Dangerous and extremely hazardous wastes are identified in lists of discarded chemical products, dangerous waste sources, and dangerous waste constituents; approximately 500 substances are designated extremely hazardous under the Discarded Chemical Products List. A waste can also be dangerous if it meets certain toxicity or persistence criteria, or if it exhibits certain characteristics such as ignitability, corrosivity or reactivity. These criteria and characteristics are defined in great detail in WAC regulations (173-303-070 to -103, q.v.).

A waste that is on one of these lists or meets one of the criteria or characteristics may not be designated dangerous or extremely hazardous if:

- For chemicals listed as extremely hazardous, less than 2.2 pounds of this waste are produced per month or at any one time;

- For chemicals listed as dangerous, less than 400 pounds of the wastes are produced per month or at any one time;

- The concentration is so low (based on calculations taking into account toxicity and persistence) as to "render the waste innocuous."

A number of waste categories are excluded from the regulations, "because they generally are not hazardous, are regulated under other state and federal programs, or are recycled..." These include (among others):

- Household wastes,
- Domestic sewage that goes to a treatment plant,
- Waste tires from motor vehicles,
- Roofing tars and shingles,
- Waste railroad ties, and
- Waste telephone poles.

Other provisions of the state regulations generally follow the federal RCRA regulations of generators, transporters, storers and disposers. State regulations will be more stringent than federal for disposal facilities managing extremely hazardous waste; no such facilities exist in Washington at this time.

At the time of this writing, the state has applied for but not yet been granted supercedence of its regulations over the RCRA regulations. If this occurs as expected, only the state regulations will apply to hazardous wastes in Washington. At this moment, however, generators, transporters, etc., have to comply with both sets of regulations.

3. Local Seattle/King County Laws

Regulations at the local level in the Seattle area address only the disposal of materials in the solid and liquid waste streams, and, in general, do not control toxic or hazardous substances to any significant degree.

(a) City of Seattle Solid Waste Ordinance. The "Regulations for Removal of Garbage and Swill" require a license to "remove through the streets" any animal remains (e.g., carcasses, fish parts, butcher's offal) or waste vegetable matter. The "Solid Waste Collection" ordinance regulates garbage and rubbish disposal in the city, garbage being defined as "putrescible" waste and rubbish as "non-putrescible." The ordinance specifies the type of containers (i.e., trash cans) to be used, rates to be charged for collection, etc. The only substances which are prohibited in garbage or rubbish are hot ashes and excrement (human or animal). Contents of cans or single items over 80 pounds will not be collected. No mention is made of toxic, hazardous or dangerous wastes.

(b) King County Solid Waste Regulations. The "Rules and Regulations establishing minimum functional standards for solid waste handling (and) prohibiting certain conduct" are established and enforced by the King County Board of Health. These regulations specifically identify and address "hazardous wastes" among the general requirements for storage and collection which are similar to the Seattle ordinance. The King County regulations also provide for disposal of wastes at permitted landfills or other sites. They categorically exempt that single family's or household's solid waste which is dumped on its own land.

Hazardous wastes are defined as "those which present or possess an inherent capability to present a threat to the public health, safety and welfare" (Section 2.18). Categories of hazardous waste include, but are not limited to:

- Radioactive wastes,
- Explosive wastes ("intended for the purpose of" exploding),
- Medical wastes, and
- Pesticides, their applicators and containers.

Hazardous wastes must be stored, collected, and transported "in a manner satisfactory to the Health Officer" (Sections 4.01 and 4.02).

The regulations specify that, "All toxic and hazardous wastes shall be neutralized or otherwise made harmless prior to disposal" (Section 4.05, (A.1.c)). Specific minimum performance criteria for pesticides are as follows:

- Routine Disposal -- Pesticides, used containers of pesticides, and other toxic materials generated during use or manufacture of pesticides may be disposed of only at an approved solid waste disposal site. Every effort should be made by the use of pesticides to decontaminate[1] and/or return pesticide containers to the pesticide manufacturer for reuse or recycling[1]. Where this is impossible, pesticide containers must be rendered unusable before final disposal at an approved solid waste disposal site. Unless an adequate enclosure is provided to prevent unauthorized entry into the disposal site, empty pesticide containers must be buried the same day of disposal.

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[1] Metro note: we do not recommend that the consumer attempt decontamination or other special disposal practices such as incineration.

- Emergency Disposal -- When, because of emergency or other unusual circumstances, large quantities of pesticides and/or pesticide contaminated material must be disposed of, it shall only be done at a site and in a manner approved by the Health Officer. The site shall be marked and recorded for future references.

- Disposal into Sewer System -- Pesticide and toxic chemicals shall not be disposed of as a waste into a sanitary sewage system.

- Disposal by Incineration -- Pesticides and toxic wastes may be disposed of by incineration[1] only when done by a process which results in complete combustion and then only when approved by the Health Officer.

- Groundwater Protection -- Pesticides and other toxic wastes shall not be placed closer than four feet (1.22 meters) from the highest groundwater level. Separating the water table and the bottom of the disposal site should be clay, a high humus content soil or other approved barrier material.

(c) Metro and Local Agency Sewerage System Regulations. Metro is the regional agency responsible for collection and treatment of sewage, including industrial and commercial wastes as well as household liquid and human wastes. Thirty-nine local sewage agencies (cities or sewer districts) in King and Snohomish Counties act as "retail" collectors at the individual hockup level, while Metro performs a "wholesale" role with large trunk collectors and treatment at five wastewater treatment plants.

Metro's "Rules and regulations for the disposal of sewage into the Metropolitan Sewerage System" (Resolution 2315) state, "No person (defined as "any individual, company...") shall discharge, directly or indirectly, into a public sewer any material or substance which is prohibited by any rules and regulations of Metro or the local Sewer Agency" (Section 12-01).

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[1] Metro note: we do not recommend that the consumer attempt decontamination or other special disposal practices such as incineration.

Metro's Industrial Pretreatment regulation (Resolution 3374) specifies two classes of wastes -- "prohibited" and "restricted" -- which no person shall discharge: "at any time or under any condition" for prohibited substances and only "in the manner prescribed" for restricted substances.

"No person shall discharge any of the following prohibited substances directly or indirectly into any public sewer..." (Section 3.01):

- Flammable or explosive materials (e.g., fuel oil, waste crankcase oil, gasoline, naphtha, benzene, toluene, xylene);
- Obstructing materials (e.g., ashes, sand, grass clippings, containers);
- Odorous materials ("capable of creating a public nuisance");
- Toxic vapors (e.g., chlorinated hydrocarbons, cyanide, sulfur dioxide, hydrogen sulfide); and
- Corrosive materials (capable of causing structural damage, including wastes with pH less than 5.5).

"No person shall discharge wastes containing restricted substances directly or indirectly...in excess of limitations specified by conditions of the waste discharge permit...or in excess of standards" (Section 4.01). These standards include:

- pH not lower than 5.5;
- Temperature not higher than 150°F.;
- Fats, oils and greases not greater than 100 mg/l in concentration;
- High strength wastes, with concentrations not to exceed the following:

--	arsenic:	1 mg/l
--	cadmium:	3 mg/l
--	chromium	6 mg/l
--	copper	3 mg/l
--	lead	3 mg/l
--	mercury	0.1 mg/l
--	nickel	6 mg/l
--	silver	1 mg/l
--	zinc	5 mg/l
--	cyanide	2 mg/l

- Mass limitations for specific substances on a pounds per day basis.

Resolution 3374 requires industries tributary to Metro's system to "pretreat" their wastes to certain permit levels before discharging into the public system for final treatment.

All of the local cities and sewer districts have ordinances similar to Metro Resolution 2315 regulating the establishment and use of sewers at the local level. Most of these ordinances have language identical or very similar to that quoted above, restricting the discharge of explosive, corrosive, obstructive and other substances. Some of these use general language such as "in such quantities or concentrations which will cause...," thus imply a small amount exemption under which most households would be assumed to fall. Others, such as the Metro regulation, identify prohibited substances of which any amount is too much. These substances fall into the same classes defined in Resolution 3374, quoted above. The City of Seattle Sewer Utility Ordinance, however, has an additional category under its "prohibited substances":

- Wastewater containing a toxic or poisonous substance, including chlorinated hydrocarbons in sufficient quantity to injure or interfere with any sewage treatment process, constitute a hazard in the receiving waters or the sewage treatment plants (Seattle Municipal Code 21.16.300).

4. Examples of Other Laws of Interest

"Right to know" laws have been enacted or proposed in a number of states and cities. Almost exclusively, these laws are concerned with exposure of workers to toxic substances in the workplace and their right to know what it is that they are being exposed to. None of these laws applies to labeling of household products under the same principle.

The City of Philadelphia's Right to Know Ordinance is the most encompassing of any existing law that has come to our attention (see Environmental Action Foundation, 1981). It pertains not only to workers' exposure inside their place of employment but also to the general public's exposure to toxicants released into the city's atmosphere by industrial or commercial practices. All such releases (routine and accidental) must be reported to Philadelphia's Air Pollution Control Board and made available to the public.

The Right to Know Ordinance of the City of Santa Monica, California, requires any person, company, etc., that handles, stores, uses, processes or disposes of any toxic, radioactive, or hazardous materials or wastes to report the identity of these substances and their route of disposal to the city's General services Director for public disclosure. This draft ordinance specifically exempts any substance that is "contained in food, drug, cosmetic or tobacco products or in consumer products packaged for distribution to and use by the general public" (Environmental Action Foundation, 1981).

Los Angeles County, in its efforts to improve air quality, has enacted an ordinance regulating the degree of volatility of paints and paint products, including a ban of the sale or use of benzene and carbon tetrachloride (Fritsch, 1978).

Nassau County on Long Island, New York, has such a fragile groundwater aquifer that the county has, among other protective measures, an ordinance prohibiting the sale or use of detergents containing phosphate-based builders such as trisodium phosphate (TSP). This ordinance is one of the classic local examples of a sales restriction ("shelf source control") for a problem household product.

A bill was introduced last year in the California legislature which would require certain product labels to give disposal information for the container the product is in: "Every substance that is determined to be hazardous...that is placed or packaged in disposable containers, bottles, or cartons shall include instructions explaining methods by which such container, bottle, or carton may be safely disposed." It died in committee.

A Minnesota law requires all service stations either to have facilities for handling the collection of used motor oil for recycling or a sign saying where the nearest waste oil pick-up location can be found. Oregon requires all retail outlets which sell more than 500 gallons per year of motor oil to post signs encouraging recycling and giving locations of the nearest service stations or other collection points. Other states have similar regulations. A bill patterned after the Oregon statute was introduced in the 1982 Washington State legislature, but died in committee.

In Denmark, a national "system for the management of waste oil and chemical wastes" has been operating since 1975 based on the Danish Parliament Act on Disposal of Waste Oil and Chemical Wastes. Called simply "The Danish System," it encompasses collection sites in every municipality in the country, a transportation network, and a central treatment and disposal site at Kommunekemi. Private citizens are encouraged to bring their oil or chemical wastes to the local collection sites; although not required to meet the same regulations as industries, citizens are "nevertheless responsible for that [sic] the disposal of the waste is carried out without polluting the environment" (The Danish System, 1980). In some municipalities, special house by house pickup is arranged. The effectiveness of this system in capturing household hazardous waste is not documented in the one report we have seen.

C. CONTENTS OF PRODUCTS

1. General Comments

A detailed examination of the contents of hazardous household products, their human health effects, environmental fates and disposal routes is provided in Report B (Toxicants in Consumer Products) of this Household Hazardous Waste series. Without attempting to duplicate that document here, we wish to provide a brief synopsis of the products reviewed, pertinent facts gleaned, and problems encountered.

A few findings are common to all four classes of toxic consumer products (pesticides, paint products, household cleaners and automotive products). In general, while toxic substances are widespread in consumer products, information on the specific constituent chemicals is often difficult or impossible to obtain. Determining the contents of familiar products is a challenge because of trade secret restrictions and because it is common for ingredients or proportions of ingredients to vary over time or geographical area. For example, a product used heavily in one region may be unavailable or of a slightly different composition in another region. Even when specific chemical constituents are known, however, information on chronic toxicities and environmental effects is patchy.

Another widespread and important data gap concerns information in quantities of products sold, used and discarded. In order to estimate the cumulative effect of numerous small, dispersed sources, knowledge of quantities is essential. Such estimates are difficult to determine for most product classes.

The labeling of products, whether for contents, directions for use, or recommendations for safe disposal, is often inadequate and sometimes non-existent. Such labeling as "active ingredient: 0.5%, inert ingredients: 99.5%" can be misleading when the unnamed "inert" constituents are themselves toxic or hazardous. Lack of clearly defined contents hinders the consumer's ability to make buying choices. Recommendations such as "Dispose of in a safe manner" do little to assist the consumer in making proper disposal decisions.

In general, household products contain less toxic/hazardous substances than those chemicals used in commercial or industrial processes. Consumer products have tended in recent years to become safer or to contain smaller quantities of fewer kinds of the better-documented toxic chemicals, either in response to regulation, economics, (including increased costs of constituents and hazardous waste disposal), the market place, or liability concerns. As documented in the next four sections, however, toxic or hazardous constituents are common in household products and warrant concern in their disposal.

2. Pesticides

As described in the Legal Framework section (A), a pesticide is a substance which destroys or repels plant and animal life which is injurious to health or the environment. This refers not only to that class of home and garden chemicals such as insect sprays and weed killers which are commonly called pesticides, but also to disinfectants and wood preservatives which contain substances that will kill or repel living organisms. (In this project, however, we have chosen to deal with disinfectants in the Household Cleaners section and with wood preservatives in the Paint Products section. This was done because most people associate these products with those categories, but it should be remembered that such products are pesticides and they should be handled accordingly.)

Pesticides are broadly classified according to the target organism: insecticides kill insects; herbicides kill plants; rodenticides kill rodents (such as rats); molluscicides kill mollusks (such as slugs); and fungicides kill molds and other fungi. There are also pest repellants, such as mosquito "dope," designed to merely repel insects rather than kill them. Synergists or activators are chemicals which may be added to a pesticide formulation to make it more effective. Within these broad classifications, pesticides may be further broken down according to their chemical class. Table 8 outlines some classes of pesticide chemicals found in consumer products, with examples of specifications in each class.

FIFRA, as described in the previous section, regulates all aspects of pesticide content, manufacture and use. It requires registration of all pesticides, classifies pesticides into general use and restricted use categories, and specifies strict labeling requirements. A few points from FIFRA are worth reemphasizing here:

- Because many pesticides were given "grandfather" registrations at the enactment of FIFRA, EPA registration does not necessarily imply that a given pesticide has been thoroughly tested for safety.

- Pesticides classified for general use (i.e., those found in consumer products) are safer than those classified for restricted use; however, restricted, suspended and cancelled pesticides, while no longer available for sale to the general public, are still found in many homes in old stocks and may still be used and disposed of.

Table 8. PESTICIDE CLASSES AND EXAMPLES FOUND IN HOUSEHOLD PRODUCTS.

INSECTICIDES

- A. Organophosphates
  - Acephate
  - Chlorpyrifos
  - Diazinon ®
  - Dichlorvos
  - Disulfoton
  - Malathion
  - Methyl-demeton
  - Naled
  - Ronnel
  - Stirofos
  - Trichlorfon
- B. Carbamates
  - Carbaryl (e.g., Sevin®)
  - Maneb
  - Propoxur (e.g., Baygon®)
- C. Organochlorines
  - Chlordane*
  - DDT*
  - Lindane (e.g., Kwell®)
  - Methoxychlor
- D. Organosulphurs
  - Ovex
- E. Botanicals/Microbials/Synergists
  - *Bacillus thuringiensis*
  - Piperonyl butoxide
  - Pyrethrin
  - Rotenone

HERBICIDES

- A. Arsenicals
  - Arsenic trioxide/Cacodylic acid
- B. Chlorophenoxy acids
  - 2,4-D
  - 2,4,5-T*
- C. Triazines
  - Prometone

(continued)

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*No longer found in consumer products, but may still be in households in old products.

Table 8. PESTICIDE CLASSES AND EXAMPLES FOUND IN HOUSEHOLD PRODUCTS (continued).

- D. Benzoic Acid Derivatives
  - Dicamba
  - Dichlobenil
- E. Phenol Derivatives
  - Pentachlorophenol
- F. Glycene Derivatives
  - Glyphosate (e.g., Roundup®)
- G. Ureas
  - Divron

FUNGICIDES

- A. Dicarboximides
  - Captan
  - Folpet
- B. Benzimidazoles
  - Benomyl
- C. Triazines
  - Anilazine
- D. Phenol Derivatives
  - Pentachlorophenol

RODENTICIDES

- A. Coumarins
  - Fumarin®
  - Warfarin (e.g., D-Con®)

MOLLUSCICIDES

- A. Aliphatic Hydrocarbons
  - Metaldehyde (e.g., Slug-Bait®)

- All pesticides must have their registration number on the label. A product can be identified as having a pesticidal function if "EPA Reg. No. _____" appears on the label.

- The name and percentage content of all active ingredients must appear on the label. These active (i.e., pesticidal) chemicals often make up only one percent or less of the total contents. The remaining contents, which could contain toxic or hazardous solvents or similar materials, are usually lumped under the category "inert."

- Certain "signal words" are required on all pesticide labels which offer clues to their relative human health hazard. A product with DANGER on the label is more acutely toxic than one with WARNING, which is in turn more toxic than one with CAUTION. The addition of POISON and a skull and crossbones to a label in the DANGER category indicates high toxicity through direct oral, inhalation or skin exposure. None of these warnings refers to environmental hazard.

- FIFRA regulations do not affect the disposal of general use pesticides, other than to recommend that they be "securely wrapped in several layers of paper and disposed of singly during routine municipal solid waste disposal."

Pesticides are a commonly used household product. Two national surveys found pesticides in over 90% of homes. Table 9 presents results of one of these surveys. As shown, many more households use pesticides inside the house (e.g., disinfectants, pet flea products, mothballs), than in yard or garden (e.g., "classic" pesticides such as insecticides and herbicides).

The usage study by Savage et al. (1980) found that the most used pesticides, in descending order by frequency of occurrence, are:

- Disinfectants (e.g., cresol, phenolics, QAC's);

- Mothballs and flakes (e.g., chlorobenzenes, naphthalenes);

- Pet flea collars (e.g., stirofos, carbaryl, propoxur);

- No-pest strips (e.g., dichlorvos); and

- Other pet pesticides, such as flea shampoos and powders (e.g., carbaryl, dichlorvos, pyrethrins).

Interestingly, the same study determined that the most commonly used specific chemicals in household pesticides, by total volume used, are predominantly the insecticides and not the disinfectants. Table 10 presents the top ten. Such a ranking does have its limitations: we might reasonably expect that pest problems vary with geography and climate, so that in the northwest, for

Table 9. USE OF PESTICIDES IN HOUSEHOLDS.
(Savage et al.,1980.)

Percentage	Type of Use
90.7%	of all households use pesticides in home, garden, or yard
83.7%	use pesticides in house
21.4%	use pesticides in garden (flower or vegetable)
28.7%	use pesticides in yard
20.6%	of all households store pesticides that have not been used in 12 months
16.4%	of all households use no-pest strips
35.8%	of all households use mothballs, flakes, or crystals
90.6%	of all households use disinfectants
28.4%	of all households use pet flea collars
13.3%	of all households use pet flea shampoos
13.1%	of all households use pet flea powders
2.0%	of all households use other pesticides on pets
41.1%	of all households bought pesticides at the grocery store, the site most frequently visited to purchase pesticides

Table 10. TEN MOST COMMONLY USED HOUSEHOLD PESTICIDES.

The pesticides used in the largest total volume per year are arranged in descending order. Ranking is from a national survey by Savage et al. (1980).

1. Dichlorvos (Vapona®, DDVP)	Insecticide	No-pest strips, fumigants
2. Resmethrin	Insecticide	Plant sprays, indoor ant and flea killers
3. Pyrethrin	Insecticide	Plant sprays, indoor ant and flea killers
4. Chlordane	Insecticide	Termite control, now restricted (No longer available for general use)
5. Carbaryl (Sevin®)	Insecticide Molluscicide	Flea killers, rose dust Slug bait
6. 2,4,5-T-Silvex	Herbicide	Weed killer, now restricted (generally replaced by 2,4-D)
7. Diazinon®	Insecticide	Home and garden pest killers
8. Propoxur (Baygon®)	Insecticide	Ant, roach, wasp killers
9. Malathion	Insecticide	Plant sprays and dusts
10. Metaldehyde	Molluscicide	Slug bait

instance, metaldehyde ("slug bait") would be more commonly used. In addition, changes in availability (e.g., chlordane is now banned) will have changed the ranking.

The types of pesticides classified for general use have changed in the past ten years. Although many persistent chlorinated hydrocarbon pesticides such as DDT have been banned, there has been a tradeoff in use in that the faster-to-break-down pesticides more prevalent today -- such as the carbamates (e.g., Sevin®) -- often tend to be more acutely toxic.

Spring weekends tend to be the period of most intense outdoor use of household pesticides. If heavy rain occurs immediately following such an intense application, the potential for environmental contamination via runoff is enhanced.

The study by Savage et al. (1980) found that 29% of all households throw unused pesticides in the trash and that 5% dispose of them down the sink or toilet. (The remaining 66% did not indicate a disposal method.)

Determination of the environmental impact of improperly disposed household pesticides is extremely difficult. Some local samples in the Seattle area have found fresh p,p'-DDT, p,p'-DDE, lindane, dieldrin, methoxychlor, 2,4-D and other pesticides in residential area runoff, storm drains, streams or lakes (Metro, unpublished data). The origin of these substances and the significance of their presence in urban water and sediments remain uncertain. Degradation rates, intermediate products, persistence times and chronic toxicities are usually unknown.

Because of these and related problems with lack of information, we were not able to establish a priority list of household pesticides of concern. Certainly those pesticides that have been cancelled, suspended or removed from the general use category, such as DDT and chlordane, are of major concern. All pesticides, including the most benign, are products containing substances designed to kill or repel some organisms and should be handled with great care. We recommend that unused or waste pesticides be disposed of only through official hazardous waste handling facilities.

3. Paint Products

Paints and paint-related items encompass a complex group of products including protective and decorative coating materials, solvents used with these coating materials, and preservatives.

Paints can be classified as either solvent ("oil")-based or water-based, depending on their primary solvent. Solvent-based paints include enamels, varnishes, lacquers -- either natural lacquers, such as shellacs and gums, or synthetic lacquers, such as cellulosic resins -- primers, stains, seals and sealants, adhesives and specialty coatings. Water-based paints can be latex or watercolors. Different sheens in paint are designed as flat, semi-gloss, or gloss and can apply to either solvent-based or water-based paints. Latex paints have steadily replaced solvent-based coatings over the last twenty years; they now account for three-quarters of all "architectural coatings" manufactured in the U.S. (Connolly and Levine, 1980).

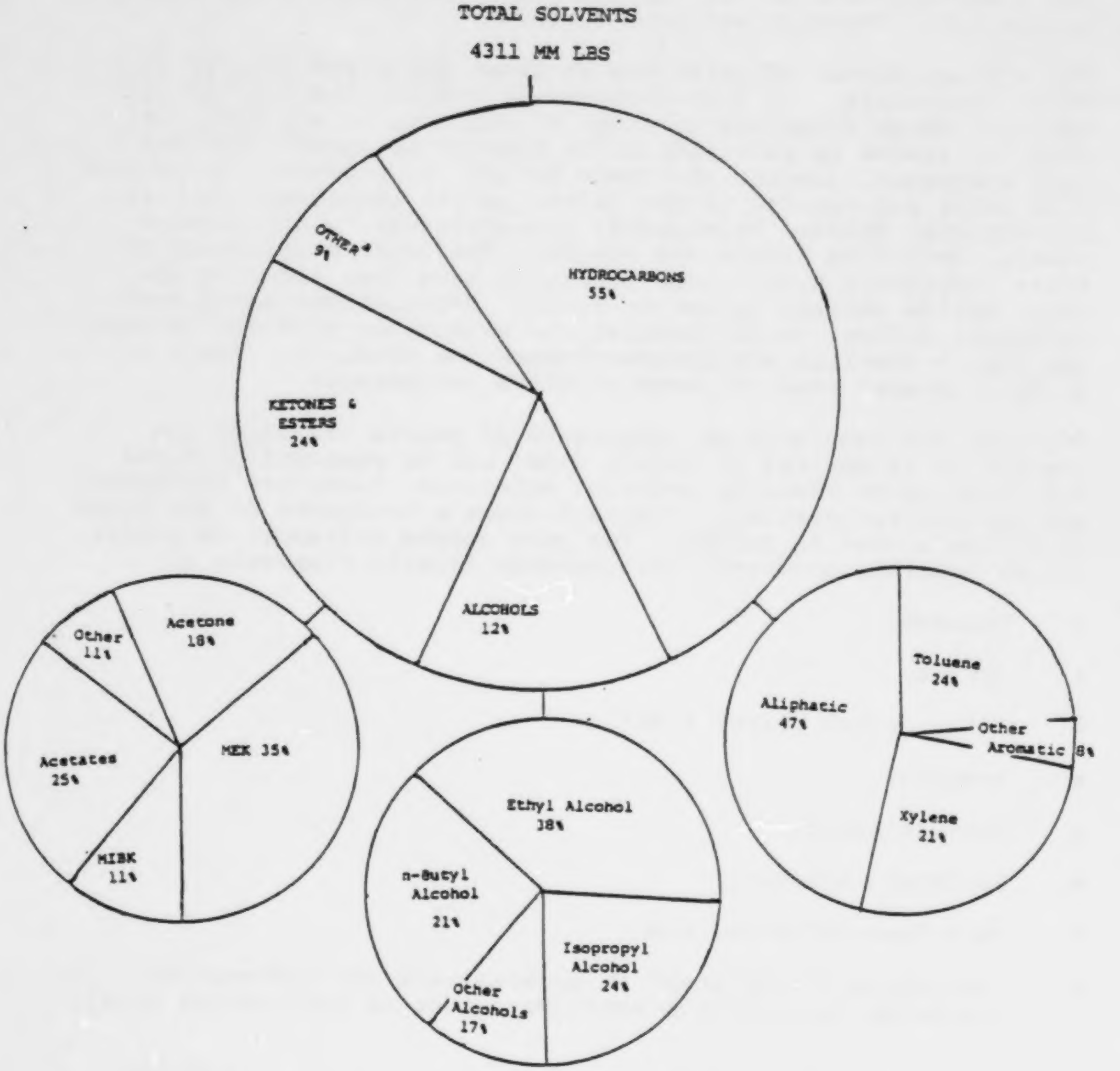
The average bucket of paint has at least three and usually four major components: 1) film-formers, or resins, the plastic-like material which forms the coating; 2) diluents or solvents, which keep the resins in solution, allow them to be spread, and which then evaporate, leaving the resin behind; 3) pigments, which provide color and opacity to the paint; and 4) additives, such as surfactants, driers, thickeners, preservatives, anti-skinning agents, anti-foam agents and others. The exact proportions of these components vary. Many producers have been reducing the total solids content in recent years. Formulations among manufacturers differ, as do formulations within one producer between the top-of-the-line and bottom-of-the-line products. Table 11 gives a general idea of these relative percentages.

Solvents are used both as components of paints (to allow the coating to be applied in liquid form) and as separate products for thinning or cleaning painting materials, furniture stripping and surface refinishing. Figure 1 shows a breakdown of the types of solvents used in paints. The most common solvents, in paints and in separate products, include such organic chemicals as:

- Toluene;
- Xylene;
- Methyl ethyl ketone ("MEK");
- Acetone;
- Ethyl alcohol;
- Isopropyl alcohol;
- Methylene chloride; and
- "petroleum distillates" (a general term for hydrocarbon fractions varying from petroleum ether to lubricating oils).

Wood preservatives are paint products that contain a pesticide. Some commonly-used active ingredients in wood preservatives include:

Figure 1. CONSUMPTION OF SOLVENTS BY TYPE IN PAINTS.
Percentages are based on 1979 market data.
(Connolly and Levine, 1980.)



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a. Includes glycols, glycol ethers and ether esters, methylene chloride and other miscellaneous solvents.

Table 11. EXAMPLE OF GENERAL COMPOSITION OF PAINTS.
(Connolly and Levine, 1980.)

Contents as shown on label	(by Percent weight) Bottom of line	Middle of line	Top of line
Resin	7.0	13.5	22.5
Pigment	3.0	12.0	23.5
Additives	18.0	52.0	47.8

- Copper naphthenate;
- Zinc naphthenate;
- Pentachlorophenol;
- Other chlorinated phenols;
- Creosote; and
- Magnesium fluorosilicate

As is true in most pesticides, these active ingredients often make up only a small percentage of the product. The inert ingredients can be any of the solvents mentioned above.

The Federal Hazardous Substances Act regulates contents and labeling of many paint products. Once-common solvents such as benzene, for example, are now prohibited in consumer products. Most paints and solvents are classified under FHSA as hazardous materials and must show the danger/caution/warning signal words on their labels as described in detail in Section II B.

The Federal Lead-Based Paint Poisoning Prevention Act restricts the contents of paint to a maximum of 0.06 percent lead (by weight). This law and similar regulations have encouraged manufacturers to use less hazardous pigments, solvents and other product constituents than such well-documented toxicants as lead chromate, cadmium and benzene.

FIFRA regulates wood preservatives. The "Active" versus "inert" categories and the "EPA Reg. No. _____" on the label flag these products as pesticides.

Use and disposal figures for those paint products sold to consumers are difficult to define accurately. Estimates of paint use per household per year vary from as little as two ounces to as much as four gallons.

Paints as a class appear to pose relatively little human or environmental hazard, especially the latex paints. Highly toxic pigments are less common in paints today, except for artists' paints, which still pose significant hazards to users (McCann, 1979). Other paint components such as the resins and fillers are generally non-hazardous.

On the other hand, the solvents in "oil" paints and in separate solvent products are materials of concern. Many of them are acutely toxic to the user while some are suspected to pose chronic hazards such as liver and kidney damage (toluene, 1,1,1-trichlorothane) or cancer (perchloroethylene). The alcohols, ketones, esters and petroleum distillates tend to be less hazardous than the aromatic and chlorinated hydrocarbons. Care should be exercised with use and disposal of any organic solvent-containing product.

Wood preservatives are among the most hazardous products found in a household, both in terms of acute and chronic human toxicity and fate and effects in the environment. The constituents of greatest concern are the chlorinated phenols, especially pentachlorophenol.

Many of the chemicals found in the latter two categories of paint products are classified as priority pollutants in the Clean Water Act and pose significant threats to aquatic organisms. The lighter weight, more volatile compounds tend to end up in the atmosphere, except in cases such as soil and groundwater discharge where the volatilization pathway is restricted. The heavier, more water soluble or particle-bound compounds move through the water environment. Such solvents as toluene and ethyl-benzene and such preservatives as pentachlorophenol have been found in local water and sediment samples (Metro, unpublished data). Their origins and possible effects of their presence in the environment are not well documented and, for many compounds or for such "sinks" as aquatic sediments, are not known at this time.

4. Cleaners

When we speak of household cleaners, we are referring to an entire range of cleaning and disinfecting products, such as disinfectants, bathroom cleaners, drain cleaners, furniture polish, dry cleaning fluid, bleach, oven cleaner, abrasive powder, air fresheners, floor cleaners and waxes, rug cleaners, upholstery cleaners and window cleaners, as well as laundry products such as detergents, fabric softeners and additives. This bewildering profusion of cleaners makes this class of products difficult to examine. Within each type of product, there are tens and sometimes hundreds of different formulations for specific uses and brands, and these formulations change over time and over geographical area. Unlike pesticides, cleaners do not consist of one easily identified chemical; rather, they are mixtures of complex and often unnamed synthetic compounds. Unlike paint products, information on cleaning chemicals is usually difficult to discover and inconclusive when found.

Detergents are substances that clean due to a combination of properties: they lower the surface tension, provide wetting, emulsifying and dispersing action, and make foam. Ordinary soap is a kind of detergent. Usually, however, the term "detergent" refers to synthetic soaps. Detergents, whether for laundry or dishwashing, solid or liquid, have certain ingredients:

- Surface Active Agents, or surfactants, lower the surface tension of a given solution, permit the fabric to be wetted and allow for loosening and removal of soil. A typical laundry detergent contains 14 to 20 percent surfactants. Common surfactants include:

  - -- linear alkyl benzene sulfonate,
  - -- quaternary ammonium compounds (QACs) such as benzalkonium chloride, and
  - -- alkyl ethoxylate.

- Builders, sometimes called sequestrants, are a major component of detergents which perform three functions:

  - -- remove (sequester) the calcium and magnesium found in hard water, thereby allowing the surfactants to work,
  - -- prevent soil from re-depositing, and
  - -- preserve the enamel on the inside of the washing machines from corrosion through an anti-caking ingredient.

  Phosphate compounds were common builders in the past; present detergents which contain "no phosphates" replace it with alternative chemicals which are often more caustic. Laundry detergent usually contains 40 to 60 percent sequestering agent, 0.5 to 0.9 percent anti-redeposition agent, and 5 to 7 percent anti-caking agent (Fritsch, 1978). Common builders include:

  - -- sodium tripolyphosphate ("STP"),
  - -- sodium carbonate, and
  - -- sodium metasilicate.

- Optical brighteners convert some invisible ultraviolet sunlight to visible blue light, thereby making the fabrics appear whiter. Optical brighteners constitute a small percentage by volume (0.3 to 0.75 percent) of the laundry detergent (Fritsch, 1978).

- Other ingredients are also added to detergents, such as fillers, foam boosters and perfumes. Fillers are "inert" substances which provide bulk and alkalinity. Foam boosters add sudsiness, and perfumes, of course, add a fresh or scented smell.

Many cleaning products contain organic solvents similar to those found in paint products, which are used in cleaners most often to remove grease. Table 12 presents a listing of common cleaning solvents and examples of products they are found in.

Disinfectants kill bacteria or fungi. They reduce temporarily (but do not eliminate) populations of household "germs" (a 'germ-

Table 12. ORGANIC SOLVENTS
IN HOUSEHOLD CLEANING PRODUCTS.
(Adapted from survey by Mackay, 1979)

	Solvent	Product(s)
1.	Orthodichlorobenzene	Drain degreaser
2.	Paradichlorobenzene	Drain degreaser Toilet bowl deodorizer
3.	1,1,1 Trichloroethane	Septic tank drain field cleaner Drain opener Oven cleaner (aerosol) Cleaning fluid Furniture polish
4.	Trichloroethylene	Cleaning fluid
5.	Perchloroethylene	Laundry degreaser Home and auto parts cleaner
6.	"Aliphatic, aromatic hydrocarbons"	Septic tank drain field cleaner Laundry degreaser Cleaning fluid Engine degreaser Car wash
7.	"Petroleum distillates" (see glossary)	Septic tank drain field cleaner Drain opener Oil and grease dissolver Garage degreaser Cleaning fluid Engine degreaser Spray cleaner Floor cleaners Furniture polish Spot remover
8.	Methylene chloride	Oven cleaner Graffiti remover Brush cleaner
9.	"Harmful organics"	Floor stripper and cleaner
10.	"Chlorinated solvents"	Laundry degreaser

free" environment can be produced only by sterilization). Cresols and phenols have been widely used as disinfecting agents, but in recognition of their high toxicity, they are being replaced in household products by substituted phenol compounds such as:

- Phenyl phenol;
- Benzyl chlorophenol; and
- Chlorocyclopentyl phenol

and by quaternary ammonium compounds (QACs) such as:

- Benzalkonium chloride; and
- Alkyl dimethyl ethyl ammonium

Undefined ingredients and lack of content information on the labels are chronic problems with household cleaners. Functional descriptors (e.g., grease cutter, corrosion inhibitor, polishing agent) and general terminology (e.g., petroleum distillates, aromatic hydrocarbons) are common but unhelpful to the consumer wishing to compare toxicities of specific chemical ingredients.

The Federal Hazardous Substances Act regulates contents and labeling of many cleaners. Some compounds that used to be found in household cleaning products but which are now banned include extremely flammable water repellents, carbon tetrachloride and liquid drain cleaners with 10 percent or more potassium hydroxide.

Active ingredients and danger/caution/warning signal words are required on labels of products containing any hazardous substances, as described in detail in Section II B.

Disinfectants, as pesticides, are regulated under FIFRA. The "EPA Reg. No. _____" on the label is a signal of a product's pesticidal function.

Household cleaners are ubiquitous products. In our survey conducted in the Seattle area (see Section III A), 97.5 percent of the respondents said they had household cleaners in their homes. Table 13 presents a selected listing of the most used consumer products sold in supermarkets. Soaps and detergents were the most frequently sold market items.

Estimates of volumes of cleaners used are sketchy, but interesting. Table 14 presents rates of use from a Chicago study by Gurnham _et al_. (1979), with tonnage per day and year calculated for the Seattle/King County area. Powder laundry soap, fabric softener and bleach lead the list.

Table 13. CONSUMER SURVEY OF MOST USED PRODUCTS. This is a partial listing of an annual supermarket sales survey, published by Progressive Grocer (1979).

Rank	Item	%Usage
1	Soaps and detergents	97.0
13	Household cleaners	91.7
22	Scouring powder	89.0
25	Furniture polish	87.9
30	Scouring pads	86.4
33	Dishwashing soap	85.4
34	Window cleaner	85.3
35	Bleach	84.4
45	Air fresheners and deodorizers	80.2
57	Bathroom cleaners	79.3
61	Oven cleaners	72.0
64	Insecticides	68.9
67	Drain cleaners	66.5
77	Milk	63.5
78	Soaps for fine fabrics	61.9
79	Fabric softeners	61.4
81	Floor wax	59.3
86	Butter	52.5
84	Rug cleaners	51.2
90	Beer	49.4
105	Kitchen cleaners	43.3
112	Starch	37.4
119	Laundry presoaks	35.3
120	Metal polish	35.2
122	Flea and tick	33.0
131	Aerosol-Pam	29.4
133	Dishwashing (auto detergent)	27.1
147	Household dye	17.7
148	Laundry additives	17.5
162	Meat extenders	6.3

Table 14. ESTIMATED CONSUMPTION OF HOUSEHOLD CLEANERS IN THE SEATTLE /KING COUNTY AREA. Rates (g/c/d) are from Gurham et al. (1979). Estimated totals for King County are based on 1980 population of 1.2 million people and are English (short) tons, not metric.

Product	grams/capita/ day	tons/ day	tons/ year
Abrasive cleaners	0.29	.38	140
Disinfectants	0.30	.40	150
Furniture polish	0.07	.09	30
Silver polish	0.07	.09	30
Floor finish	0.02	.03	10
Drain cleaners	0.2	.26	95
Liquid household cleaners	4.15	5.40	2000
Glass cleaners	0.4	.53	190
Toilet bowl cleaners	1.19	1.57	575
Liquid dish detergent	6.17	8.16	2980
Dishwasher detergent	3.62	4.79	1750
Liquid laundry soap	4.40	5.82	2120
Powder laundry soap	19.11	25.28	9230
Fabric softener	10.39	13.74	5010
Liquid cold water wash	0.02	.03	10
Bleach	9.92	13.12	4790
Powder bleach	1.47	1.94	710

Unlike many other toxic products, household cleaners pose a problem not as much through their disposal as through their use. Cleaners normally are not disposed of, in the sense that excess or leftover quantities of the substances are considered waste and dumped; instead, they would tend to enter the environment through their everyday use. Normal use of these products in many cases results in the chemicals being added to the household wastewater. In areas where this wastewater enters an on-site treatment facility (septic tank/drainfield), the potential exists for groundwater contamination.

Most household cleaning products are acutely toxic to humans and account for the vast majority of poisonings reported each year in the U.S. Chronic hazards, although not well documented for consumer product use, are significant for many of the organic solvents. A wide range of serious chronic effects have been shown to be caused by exposures to some of these organic compounds, including cancer (perchloroethylene), mutations (1,1,1-trichloroethane, perchloroethylene), neuromuscular and narcotic effects (methylene chloride, petroleum distillates, other hydrocarbons) and liver and kidney damage (1,1,1-trichloroethane and petroleum distillates).

These solvent compounds may pose environmental hazards as well, particularly if direct ground discharge restricts their volatilization and eventual breakdown in the atmosphere. The chlorinated phenols in disinfectants may also present environmental hazards because of their relative stability and halogen-produced toxicity.

Many of the household cleaners that are most acutely hazardous in their concentrated form are not a problem in the environment through normal use or disposal. This general statement is particularly true for the strong caustic (acidic or basic) products used as drain cleaners or clogged-drain openers, such as hydrochloric acid, sodium hydroxide and sodium hypochlorite. While presenting very high hazard to the user, once diluted in wastewater or the environment the constituents are benign and degrade rapidly. Such products exemplify the differences between acute human hazard and long-term environmental hazard common to many products and problematical to such studies as ours!

Unlike many other hazardous household products (e.g., gasoline or paint), many alternatives exist for the use of safer or more benign household cleaners. Information on alternatives is available in the following references:

- "99 Ways to a Simple Lifestyle" (Center for Science in the Public Interest, 1977);

- "The Household Pollutants Guide" (Fritsch, 1978).

5. Automotive Products

Motor vehicle products include such diverse items as gasoline, oil, cooling system additives, cleaners and polishes, paints, brake and transmission fluids and battery acid. Many of these products, specifically the fuels and lubricants, are fractions distilled from crude petroleum and chemically treated with additives.

Gasoline is a mixture of light, highly volatile hydrocarbons which contains numerous additives such as anti-knock agents, anti-rust compounds, anti-oxidants, metal deactivators, detergents, dyes, and de-icers.

Automotive lubricating oil is a mixture of heavier hydrocarbons than in gasoline. "Virgin" oil is derived directly from crude petroleum stock, while "re-refined" oil is recycled oil that has been treated to a quality usable again as an automotive lubricant. Both types of oils contain additives similar to those found in gasoline.

Antifreeze is a glycol-based product used in radiator fluid to prevent both freeze-ups and overheating. The major ingredient is ethylene glycol, with small amounts of additives such as rust inhibitors.

Brake fluid is composed primarily of glycol ethers, while transmission fluid is similar to motor oil in its hydrocarbon base. The major hazardous components of batteries are the sulfuric acid and lead used as media for electrolytic exchange.

As anyone who drives a car is aware, federal Clean Air Act regulations have changed the contents of gasoline over the past ten years. The reduction of tetraethyl lead as an anti-knock additive has resulted in an increase of alternative components such as benzene and polycyclic aromatic hydrocarbons.

The federal Used Oil Recycling Act of 1980 removed the earlier requirement that re-refined oil be labeled "previously used" and required that all oil be labeled with the statement, "Don't Pollute -- Conserve Resources; Return Used Oil to Collection Centers."

Federal Clean Water Act regulations prohibit dumping of gasoline or oil into water or into a storm drain or combined sewer that has the potential to get into water. It takes very little oil (less than one pint) to produce an illegal film or sheen over a large surface of water.

About fifty percent of automotive oil is not directly burned or consumed in use, but is disposed of as waste in some way. Loftness (1981) estimates that eight million gallons of lubricating oil are sold to do-it-yourselfers in Washington State each year, and of that about 4.5 million remains after use. Table 15 presents results of two studies of disposal means used by do-it-yourselfers. As shown, dumping in a hole in the backyard is the most popular disposal method.

Recycling of used motor oil is extremely convenient, as almost every full-service gas station will accept household quantities. Studies have shown, however, that only 13 to 15% of those who change their own oil recycle it. Oil that is "recycled" can be either reprocessed or re-refined. Reprocessed oil has only the water and solids removed, and is then sold for heating fuels, road oiling, wood preservatives and other uses. Re-refined oil is treated with heat, pressure and chemicals so that it is usable again as automobile lubricant. Re-refining is the environmentally-preferred recycling strategy since it reuses the oil and prevents it from entering the environment.

Unfortunately, Washington State has no re-refining capacity at this time, although one plant is now operating in Vancouver, B.C. The majority of waste oil in this state is reprocessed and burned as fuel. While this is more economical at the moment than re-refining, pollutants, particularly lead, other heavy metals and aromatic hydrocarbons, are released in significant quantities into the air through this method. Even more hazardous emissions would result if substances such as pentachlorophenol or PCBs are mixed (improperly, and, in the case of PCBs, illegally) with the waste lube oil. The standard procedure to overcome the general contaminant problem is to dilute the waste oil with virgin oil to the point where emissions of contaminants meet local air quality standards. This solution does not address the issues of total air emissions or ultimate disposal of the contaminants (as well as the economics of a wasted resource).

Petroleum products pose a number of problems in the aquatic environment. Their physical presence can result in surface coatings on water, sediments and organisms and their toxicological properties can cause acute and chronic effects. The additives and contaminants in the gas and oil products are generally of far greater concern than the petroleum hydrocarbon base.

Gasoline is an extremely flammable and poisonous substance. It is considered by most fire departments to be the single most hazardous substance commonly found in households.

Ethylene glycol, the major component of antifreeze, is highly toxic to mammals but has a relatively low toxicity to aquatic organisms. Once diluted, it appears to be adequately handled in a wastewater treatment plant, but it still poses an environmental threat if dumped in a large, undiluted dose into a storm drain or stream. The contaminants in used radiator fluid may present as much or more of a hazard as the glycol.

Table 15. MEANS OF DISPOSING OF USED OIL BY THE DO-IT-YOURSELFER.

	EPA (1973)		Oregon 1977-8[a]	
Means of Disposal	Absolute Frequency	Relative Frequency	Absolute Frequency	Relative Frequency
Dump in backyard or elsewhere on property	157	33.6%	86	26.3%
Take to service station	73	15.6%	36	11.0%
Take to public dump	54	11.6%	14	4.3%
Dump in storm sewer	53	11.4%	6	1.8%
Dump in garbage can	50	10.7%	40	12.2%
Dump in empty lot	16	3.4%	12	3.7%
Pour down toilet	4	0.9%	1	0.3%
Sell	3	0.6%	4	1/2%
Pour down sink	2	0.4%	--	--
Use around the house	3	0.6%	--	--
Dust control	--	--	71	21.7%
Weed control	--	--	12	3.7%
Burn in incinerator	--	--	10	3.1%
Coat logs/fence posts	--	--	8	2.4%
Take to recycling center	--	--	7	2.1%
Other	52	11.2%	20	6.2%
	467	100%	327	100%

a Geyer and Glendening (1979)

D. EFFECTS IN THE ENVIRONMENT

1. Introduction

Is the disposal of household hazardous waste a problem? Can we document that residences are a source of toxic pollutants? An analysis of the toxic content of products has shown that the potential exists for environmental contamination. Has that potential been realized or documented? We will first examine all the possible ways in which household toxicants can enter the environment, and then follow with a review of available information on the major pathways.

The average householder, when faced with the problem of hazardous waste disposal, has a range of different options from which the can choose. The options, similar to those available to industry, include:

- Not disposing: Using the substance up as directed, or giving it to someone who will use it, are methods applicable for some "wastes" such as paint and household cleaners. This is not an advisable option for banned pesticides or contaminated crankcase oil.
- Not disposing: Storing -- holding onto old wastes indefinitely on the back shelf is a common practice (especially for paints and pesticides) but is not really a "disposal" method.
- Recycling: Reprocessing the waste for reuse is a viable alternative for only a few toxic household products, notably petroleum-based products such as oil, transmission fluid, and solvents. (Allowing the paint sludge to settle out and reusing the solvent can be considered a form of recycling.)
- Neutralization: While possible to do for some acids and bases found in the home, this is not a commonly used or recommended household method of detoxifying for disposal, because it is potentially hazardous for the non-chemist to do properly.
- Burial or spreading on ground: This is a viable option for some products and under some sets of circumstances. It would be fairly feasible in a rural setting, where the disposal site could be chosen far from gardens, streams, and wells, and in a place that would not be disturbed by children or animals. In an urban setting, such an ideal site is unlikely to be found. Therefore, the burial option would not be recommended for city dwellers. Furthermore, burial or ground-spreading is a feasible option only for those products which will biologically degrade over time, such as some pesticides, antifreeze and some solvents. In general,

for most householders, this method is neither particularly attractive nor recommended.

- Burning: This option, like burial, is inconvenient and dependent on an adequate site. Furthermore, it is extremely dangerous, often releasing undestroyed chemicals into the air; for some products it is illegal.

- Landfilling: Disposal via the trash/solid waste collection system is the most common option for solid wastes, empty containers, and in many cases even liquid wastes (when the small quantity of liquid is placed in a container.)

- Wastewater: A variety of household wastes are disposed of in the liquid waste collection system, i.e., down the drain or toilet. The ultimate fate of the chemicals in wastewater and the applicability of this option for those chemicals depends on the type of system used by the household. This option can actually be viewed as two different disposal methods, either via

  -- septic tank/drainfield ("on-site") treatment systems, or
  -- sewer lines connected to the regional ("central") sewage collection/treatment system.

Out of all the options listed above, studies have been done on only a few of them: recycling, landfilling, on-site wastewater treatment and sewage collection/treatment. As these appear to compromise the most frequently used methods, they are of greatest concern. Each of these disposal methods is examined in the following pages, wherein we try to discover the extent to which domestic sources contribute to toxic pollution.

2. Recycling

The majority of studies on recycling that we are aware of have examined the economic feasibility of recycling of paper, glass, aluminum, and so on. To our knowledge, there has not been any effort to recycle household quantities of hazardous waste, except for used motor oil, as described in the previous section, Automotive Products (Section II C (5)).

Waste exchanges are a form of hazardous waste recycling and reuse that is used in some areas by large generators. In this process, a generator with a waste to offer contacts the waste exchange; likewise a user who needs a certain material sends in a request to the waste exchange. The exchange works as an information clearinghouse and publishes the generator's offer and user's request, utilizing a coded number system which guarantees confidentiality. The generator and user then negotiate directly. There are also materials exchanges, in which the wastes are transferred, physically, economically and equally to the exchange; the user then buys the waste directly from the exchange. This program has been very successful in England, where the U.K. Waste Material Exchange, during five years of operation, has exchanged about 156,000 tons/year, plus about 196,000 tons as single transactions with an estimated "as new" value of over $18 million (U.S. EPA, 1980a). The possibility of a similar operation being established for household waste is slight -- the wastes generated by households are usually of insufficient volume. However, if it caught on, such a program could be successful.

3. Landfilling

There have been a great number of studies done to document the composition and volume of solid waste, both on the national and local levels. Table 16 shows some estimates as to the percentage by weight of certain components in the local solid waste stream. You will note that column (2) is specifically for residential wastes.

Los Angeles County Sanitation District conducted a study in 1980 to determine the volume of hazardous materials found in residential solid waste (Bergin, 1982). The District thoroughly inspected 29 loads of refuse, totalling 155 tons, of which about half were strictly residential, while the other half were either strictly commercial or mixed residential/commercial. It found that 92% of the containers were empty; Table 17 provides a breakdown of these containers. Those that were not empty contained a total of 49 gallons of hazardous liquid (solid:liquid ratio of 759:1), and consisted primarily of used motor oil (45%), paint and building materials (29%), and gasoline and solvents (20%). The County Sanitation District concluded that the capacity of its landfills was sufficient to absorb this liquid and that "the amount of hazardous material in normal domestic and commercial refuse is so small that the hazard posed by it is insignificant" (Bergin, 1982). This particular study was done in a part of the country with very low rainfall, and thus, we assume, has less of a leachate problem than other areas.

Leachate is contaminated water which is produced when rain or other water passes through the wastes at the landfill, and picks up various mineral, organic and other contaminants. If allowed to migrate from the site, leachate may contaminate ground or surface waters. According to Shuster (1976):

> Information on leachate migration from damage cases and specific site studies coupled with general information on disposal site locations and operations in the United States indicate that at least one-fourth and possibly

Table 16. ESTIMATED COMPONENTS OF LOCAL SOLID WASTE STREAMS

	Content Percentage by Weight		
	(1)	(2)	(3)
- Paper and Paper Products	44.0%	34.4%	37-60%
- Glass	8.0	7.8	6-12
- Metal			
Ferrous	6.5	5.4	7-10
Non-Ferrous	1.5	1.2	
- Synthetic material	5.0	3.1	1-3
- All other (demolition, rubbish, kitchen waste, moisture)	35.0	48.1	17-32

(1) Source: King County Department of Public Works, N.D. For a seven-county Puget Sound area.

(2) Source: Seattle Departments of Engineering & Lighting, 1974. Figures are residentially oriented.

(3) Source: Battelle Institute, 1971.

Table 17. CHARACTERIZATION OF HAZARDOUS RESIDENTIAL SOLID WASTE FROM LOS ANGELES (Bergen, 1982).

Product	Total # Containers Found	%	# Containers Empty	%
Automotive Products	618	30%	596	31%
Personal Items	338	16%	314	17%
Household and Cleaning Products	823	40%	779	41%
Insecticides and Herbicides	51	3%	43	2%
Paints and Allied Products	155	7%	103	6%
Other	71	4%	62	3%
TOTALS:	2,057	100%	1,897	100%

> as many as three-fourths of the municipal land disposal sites in the United States have leachate migration problems.

The high rainfall volumes in western Washington increase the potential for leachate migration problems at our local landfills. The King County (Cedar Hills) landfill uses a process whereby the leachate is collected, tested and treated before disposal in Metro's sewage collection/treatment system. Although some data are available on chemicals in the leachate of the Cedar Hills landfill, the data are not pertinent to our study because the landfill has received commercial and industrial wastes as well as residential, over the years. To our knowledge, no studies have been performed on landfills that have had wholly residential sources.

4. Septic Tanks/Drainfields

Residential wastewater carries feces, garbage, "graywater" (from laundry or bath) and other sewage components from the home. Wastewater comes primarily from the bathroom, kitchen and laundry. While overall volumes of flows differ around the country because of climate, cost of water supply and other factors, percentage contributions to the household wastewater from sources in the home are fairly consistent, as shown in Table 18. About 75% of domestic wastewater is from bathing and toilet flushing.

The disposal of household products via the drain or toilet results in a wastewater that is chemically complex. We know from our examination of product contents (see next chapter) that the wastewater coming from a modern household contains organic and inorganic chemicals from diverse sources, such as disinfectants, cleaning materials, paint, pesticide products and solvents. These chemicals are generally present in the wastewater at the part per billion concentration level (Hathaway, 1980) -- greatly diluted by the mass of water used in the transport or from the bath -- but may occasionally reach significantly higher levels for short periods when larger amounts of excess or waste products are dumped.

A well-designed, well-maintained septic tank/drainfield treatment system is capable of significantly reducing the levels of most conventional pollutants, including such indicators as total and fecal coliform (bacteria), BOD, phosphorus, etc. However, these systems were not designed to treat toxic substances. Such chemicals may pass right through unaltered or cause system upsets by disturbing the bacteria in the tank.

(a) Groundwater Resources. The primary reason for concern about these toxic or hazardous pollutants in on-site systems is groundwater contamination. On a national level, groundwater

Table 18 . TYPICAL RESIDENTIAL WASTEWATER FLOWS.

Units are percentage of household use, as assembled by Gurnham et al. (1979).

	Content Percentage by Volume		
	(1)	(2)	(3)
Bath	37%	30%	30%
Toilet	41%	45%	40%
Kitchen	6%	6%	6%
Laundry	4%	4%	15%
Cleaning	3%	3%	--
Drinking	5%	5%	5%
Car Wash	1%	1%	--
Lawn Sprinkling	3%	3%	--
Miscellaneous	--	3%	4%
Total	100%	100%	100%

(1) Ligman et al. (1974).

(2) Bailey et al. (1975).

(3) Am. Water Works Assn (1978).

represents over 95% of all the available freshwater (including the Great Lakes) and is the drinking water source for about 80% of all public water supplies (Dyksen and Hess, 1982). In Washington state, more than 60% of the population is supplied by groundwater (DeWalle and Schaff, 1980). Furthermore, the 1970 census noted that 34.7% of all housing units in Washington state were unsewered, using septic tanks, cesspools or other on-site treatment systems located on individual lots (Bureau of the Census, 1972).

Numerous studies have been done in recent years which document widespread groundwater contamination in the U.S. by organic chemicals as well as conventional pollutants. These documented cases include at least two in Washington state: the Spokane aquifer and the Chambers Creek-Clover Creek aquifer south of Tacoma. As monitoring programs are completed, it is expected that all areas of the country will be found to be affected to some extent by organic contamination, according to Dyksen and Less (1982).

While households are certainly not the sole source of groundwater pollution, they are frequently cited as a contributing factor. Miller and Scalf (1973) report,

> In a series of five regional studies sponsored by EPA since 1970, local, State and Federal officials, consultants, water well drillers, and other water resource professionals in 35 states were interviewed concerning groundwater pollution problems. Septic tanks and cesspools rank highest in total volume of wastewater discharged directly to groundwater and were the most frequently reported sources of contamination. Contaminants identified included bacteria, viruses, ammonia, nitrates, chlorides, phosphates, and sodium.

(b) Presence of organics in septage. What is the nature of the contribution of organic chemicals by septic tank/drainfield systems to groundwater? The paucity of information on this subject makes it difficult to answer the question. Until recently, the majority of studies of pollution from septic tanks have looked only at the "conventional" parameters mentioned above, and not for those which might be due to complex organic chemicals or heavy metals from a variety of household products. MacKay (1979) sampled the domestic wastes collected by "cesspool waste scavengers" and found high levels (630 ppb) of 1,1,1-trichloroethane and a lesser amount (80 ppb) of chloroform.

One part of Metro's Toxicant Pretreatment Planning Study (TPPS), which is in progress at this time, is an investigation into the sources of toxic pollutants to the treatment system. As part of this project, three samples were taken from septic tank septage. These samples consisted of composites from 11 to 16 individual septic tank cleaning trucks, primarily from residential sources, although other inputs such as bilgewater and chemical toilet pumpings were present as well. Table 19 shows the organic chemicals found in these composite samples in concentrations greater than 100 ppb, and their concentration ranges. Only three compounds were found in all three samples: 1,4 dichlorobenzene, di-octyl phthalate, and toluene. The dichlorobenzene is used in disinfectants, and probably originated from chemical toilets. The phthalate, which was also the compound found in the highest concentrations, is a common component of plastics, and could have come from the plastic piping used in homes or in the pumping process. Toluene is a ubiquitous chemical, its most likely domestic origins unknown. In addition to these three compounds, four other compounds were found in all three samples but in concentrations less than 100 ppb: tetrachloroethylene (range:<5-60) and trichloroethylene (<5-50), both of which are commonly used solvents; 4,4-DDE (range: 1.6-19), a persistent pesticide; and various PCBs (range: 3.5-54). The presence of the DDT-breakdown product DDE in one sample is interesting, in that the parent pesticide has been banned for more than ten years.

(c) Movement of organics to groundwater. Once we know that these organic compounds are found in domestic septage, we need to determine whether they are removed before the effluent reaches the environment. An unpublished study by DeWalle *et al*. (1981) reported many complex organic pollutants in domestic septic tank effluent in significant concentrations. Five of the major organic pollutants found (Table 20) showed essentially no removal during the one-day detention in the septic tank. The dichloromethane, chloroform and tetrachloroethane were probably produced during the chlorination of the drinking water. However, it is likely that the toluene and ethyl benzene were directly introduced into the wastewater by their disposal by the householder, moved through the treatment system unscathed and were then available to enter the soil environment. Of interest is the fact that these pollutants tended to show higher levels on the weekends, probably due to leisure activities and related chemicals (paint thinners, toilet bowl cleaners, etc.). According to DeWalle *et al*. (1981), "Most of the other...compounds were hydrocarbons and their removal by the septic tank generally *decreased* with increasing molecular weight."

(d) Fate of organics in groundwater. Once they enter the soil environment through the drainfield leachate, many of the synthetic organics are relatively immune to microbial degradation (Kerr Environmental Research Lab, 1977). The manner in which organic compounds are transported in groundwater environments is complex, and is most strongly influenced by degradation and/or sorption onto soil particles. It appears that the low molecular weight

Table 19.

ORGANIC POLLUTANTS FOUND IN CONCENTRATIONS GREATER THAN 100 PARTS PER BILLION IN SEPTIC TANK SEPTAGE SAMPLES.

(Values are concentrations in ppb=ug/kg, from unpublished Metro data.)

Compound	Sample #1	Sample #2	Sample #3
1,3 dichlorobenzene			290
1,2 dichlorobenzene			5600
1,4 dichlorobenzene	400	270	800
1,2,4-trichlorobenzene			760
Fluorene		120	
Phenanthrene		580	120
Fluoranthene		1480	130
Pyrene		1710	110
Di-octyl phthalate	4600	6500	130
Di-n-butyl phthalate		740	130
Butyl benzyl phthalate		740	130
Diethyl phthalate			
Phenol		410	340
2 methyl phenol		210	
4 methyl phenol		1300	2400
Benzene			160
Methylene chloride	600	520	
Toluene	600	1200	150

Table 20.

VOLATILE ORGANIC COMPOUNDS IN RESIDENTIAL SEPTIC TANKS. Values are concentrations in parts per billion or ug/l from 24-hour composite samples averaged over seven days. (DeWalle et al., 1981.)

	sample type			
ppb=ug/l	Sewage	Effluent	Scum	Solids Accum.
Toluene	34.6	38.8	0.7	0.02
Dichloromethane	3.6	3.4	0.9	0.25
Chloroform	1.7	0.76	0.1	0.06
Tetrachloroethane	0.76	0.28	5.8	7.6
Ethylbenzene	0.1	0.1	6.9	6

halogenated hydrocarbons (e.g., tetrachloroethane, 1,4-dichlorobenzene) neither degrade nor adsorb to soil particles but are transported readily in sandy soil (Wilson et al., 1981). This is especially true in situations where volatilization is reduced, such as in septic tanks and drainfields. Even other organic molecules which do adsorb to soil, but are difficult to degrade, may eventually reach groundwater as they slowly migrate into and through an aquifer (Kerr Environmental Lab, 1977).

(e) Protecting groundwater resources. As has been shown in the previous section, there is theoretical evidence to suggest that contamination of groundwater by the disposal of toxic consumer products via septic tank/drainfield systems is likely. Many studies allude to "suspected sources" without detailing actual data. It has been proven difficult to find clearly documented connections between toxicants seen in groundwater and domestic sources, since most testing has been done on large aquifers with mixed sources. To our knowledge, only the use of organic solvent septic tank/drainfield cleaners has been directly connected with groundwater contamination, as discussed in the next section.

One case that has come to our attention, while not based on actual field data, still sets an interesting precedent. A Connecticut developer applied for a permit to discharge septic tank/drainfield-treated sewage from a condominium unit into the groundwater of the town of Guilfords. The proposed development shared a common boundary with the town's well field, which produced drinking water for 5,000 residents. Connecticut's Department of Environmental Protection, in its review of the permit application, determined that the system could adequately remove or dilute "normal" pollutants to acceptable levels. In its attempt to determine the "potential discharge of toxic or hazardous chemicals originating from household occupancy," the DEP staff made the following key points (May, 1980):

- Acceptable levels of hydrocarbons and organohalides in drinking water are subject to debate. They behave in several ways in the soil/groundwater system: while some are absorbed or degrade, others are not affected and can migrate and affect water supplies.
- A large number of domestic products contain some percentage of various organic solvents; however, the amount utilized in a household, the amount discharged and the form of discharge are not well known. Some limited sampling of private household septic tank systems does not indicate the presence of significant amounts of organic solvents. This does not mean that individual cases of gross abuse cannot occur. These cases can occur and have been documented.
- If a decision (by the Commissioner) was reached that domestic sewage would normally contain organic solvents, then

virtually all land treatment sewage systems (e.g., septic tank/drainfields) would be in jeopardy, and Connecticut's entire control program would be meaningless.

- There was difficulty in evaluating the risk because of the slight chance of extensive movement and because the chance of an organic solvent discharge in any significant amount was difficult to assess.

The DEP staff concluded that contamination was unlikely, and that the chance of contamination could be reduced by imposing stringent permit conditions, occupant education, effluent sampling, etc. The staff recommended that the permit be granted. The Commissioner, however, denied the permit application, stating that he could not say for sure that the proposed system would protect the local groundwater. He stated, "The record is threaded throughout with testimony from experts representing all parties including the applicant hedging their comments as to the degree of risk involved. I cannot ignore this threat to the health of so many people in the face of all the uncertainty that surrounds this application" (Pac, 1981).

(f) On-site system cleaners. Cleaning products used specifically for degreasing septic tanks, drainfields or cesspools have received particular attention for two reasons: 1) they are designed to be directly discharged through the systems into the ground, and 2) they often consist of chlorinated hydrocarbons such as 1,1,1-trichloroethane, methylene chloride and 1,2-dichlorobenzene, which neither adsorb onto soil particles nor degrade. Four separate studies on this particular consumer product have come to our attention.

- MacKay (1979) conducted a consumer product survey in Nassau County (New York) to "identify and abate sources of organic compounds discharged to the groundwater." She gathered information on nearly 1,000 products and evaluated them to determine their contribution. Organic solvent cesspool cleaners were assigned a high priority because of their direct discharge. MacKay found that, in Nassau County alone, an estimated 76,500 gallons of this product were sold each year. Table 21 provides a breakdown of the types of chemicals used in these products. That study recommended to the New York State Attorney General that control measures over the manufacture, sale and use of such products in the State be implemented.

- In a related study in Nassau County, Colton et al. (1979) determined that, "Use and disposal of consumer products containing organic chemicals is a suspected major source of groundwater contamination." In particular, they identified use of cesspool and drain cleaners as cause for "significant concern for groundwater quality..."

Table 21.

VOLUMES OF ORGANIC SOLVENT CESSPOOL CLEANING AND DRAIN OPENING PRODUCTS SOLD IN NASSAU COUNTY, NEW YORK. Qauntities are as of September, 1978. (Mackay, 1979).

Chemical	Quantity (Gallons/Year)
Methylene Chloride	17,400
1,1,1-Trichloroethane	18,600
Orthodichlorobenzene (1,2,-)	2,000
Other aromatic and halogenated compounds	21,750
Total suspected carcinogenic or other harmful organics	59,750
Petroleum Distillates	6,000
Inert or undetermined chemicals	10,750
Total	76,500

- Andreoli *et al*. (1980) investigated the effect of organic solvent cleaners on septic tank/"leaching pool" systems and their movement into groundwater in Suffolk County, New York. ("Leaching pools" are large, bottomless tanks used with septic tanks in place of drainfields in porous-soil areas such as Long Island.) The two organic compounds which were the active ingredients of the cleaner tested (1,1,1-trichloroethane and methylene chloride) were detected more than four feet below the bottom of the leaching pools in concentrations far exceeding state drinking water standards. Interestingly, the use of the cleaners did not improve leaching rates in the clogged tanks. The researchers recommended that the use of such chemical products be prohibited and alternate methods be considered. A ban on use of these products in Suffolk County was put into effect in 1980. Furthermore, New York state has passed a law restricting the use of cesspool cleaning products that contain certain chemicals.

- An actual contamination incident was discovered in the Farmington Valley Health District, Connecticut, in November, 1978. The FVHD had been conducting intensive well sampling in the area due to possible soil and groundwater contamination from a commercial source. During this investigation, they found high concentrations of chlorinated hydrocarbons in a well which could not have been contaminated by the commercial source. Conversations with landowners revealed that they had recently used a septic tank and drain cleaning compound. An examination of the hydraulic considerations revealed that it was very likely that the effluent from the residential septic tank could travel and enter the drinking water well. A comparison of the well water analyses, septic tank effluent and an analysis of the drain cleaning compound clearly showed a correlation (Marin, 1979). The State Department of Environmental Protection concluded that the chlorinated hydrocarbon compounds had contaminated this well and possibly other wells in the area. Furthermore, Marin (1979) states, "[The Department of Environmental Protection] had extensive experience with similar compounds that have contaminated several public water supply wells."

5. Sewage Treatment System

The wastewater of a household on a certain sewerage system will merge with other residential, commercial and industrial wastes and be treated at a publicly-owned treatment works ("POTW") such as Metro's wastewater treatment plants in King County. Because such POTWs are major point source dischargers of treated wastes to receiving waters, they have been extensively studied for both "conventional" pollutants and, more recently, for organic compounds and heavy metals in their influent and effluent. Less work has been done on the sources of those pollutants; those POTWs that have attempted to define sources have tended to concentrate on the industrial contribution.

Although industrial discharges appear to be the primary contributors of toxic compounds to POTW influent, recent studies show that "significant portions (of toxic metals and organics) in municipal sewage come from non-industrial sources" (Foess and Ericson, 1980). Flow analyses have revealed that domestic wastes are a major constituent of the volume of influent reaching the POTWs in Metro's system (Healy, 1979). It is reasonable to assume that this domestic volume would contain some proportion of the toxicant loading. In investigating the extent of this contribution, it is useful to examine separately the heavy metal and the trace organic components.

(a) Heavy Metals. The domestic contribution of heavy metals has been more thoroughly researched than that for organics. This is in large part due to the fact that heavy metals have traditionally been analyzed along with the conventional parameters of biochemical oxygen demand, chemical oxygen demand, total suspended solids, etc. By combining the data from six cities, the domestic contribution of heavy metals has been calculated; Table 22 shows these results. While in some cities as much as 71% of the total cadmium loading was from residences, residential wastes are typically responsible for only about one-fourth of the total loading; the average domestic contribution for metals was 25.8% (Gilbert, 1979). These comparisons refer to fractional contributions -- concentrations vary tremendously from city to city. According to Davis and Jacknow (1975), "The residential sector's contributions of heavy metals may be significant in large cities where the industrial mix is relatively low in metals fabrication."

Locally, the study by Healy (1979) in Metro's systems found that domestic contributions of copper and zinc are at least 20% of the total load, and, at one plant, reached 35% for zinc and 24% for copper. This is attributed to the copper and galvanized piping which is used to conduct domestic water supplies and some sewage, rather than from any household products. At this same plant, 50% of the lead load was from domestic origin, also attributed to leaching from pipes. In general, Healy found that the heavy metal levels from domestic sources in Seattle are not necessarily greater than corresponding levels in tapwater.

The most comprehensive study of domestic contributions of heavy metals was conducted in Chicago by Gurnham et al. (1979). Two non-industrial, non-commercial sampling sites were used. While they noted that "wide ranges of analytical results were the rule among the daily composites, among the time-separated runs and between the two sites," they found the following average concentrations:

Table 22.

URBAN DOMESTIC CONTRIBUTIONS OF METAL POLLUTANTS IN PERCENT OF TOTAL LOADING.
(Gilbert, 1979)

Pollutant	City							Mean	Standard Deviation
	New York	Muncie	Pittsburgh	Buffalo	L.A.	Wisconsin	Michigan		
Cadmium	18%	71%	62%	0%	17%	12%	8%	26.9%	(1.04)
Chromium	38.3	2.9	2.3	--	2.0	--1	--	11.4	(1.58)
Copper	84.8	48	16.5	2.0	13	45	40	35.6	(1.58)
Lead	--	13	63	14	--	36	33	31.8	(0.64)
Nickel	55.5	20	17.9	0	12	21	6	18.9	(0.95)
Zinc	31.8	31.6	30.8	15	25	45	32	30.2	(0.3)

> Cadmium, 1.8 micrograms per liter; chromium, 5.5; copper, 43 (32 at Oakdale, 92 at Hanover Park, where copper plumbing predominates); lead, 17; mercury, 0.3; nickel, 20; and zinc, 107 (34 at Oakdale, 215 at Hanover Park, with no obvious reason for this difference).

Gurnham et al. (1979) took their investigations a step further and examined potential sources of these heavy metals, and the discrepancy between the two sites. As Table 23 indicates, the water supply was a major source of heavy metals. They state, "At Oakdale, the water contributes more than half of most of the metals in the sewage (35 percent of the copper and as much as 95 percent of the zinc). At Hanover Park, tap water furnishes 85 percent of the nickel, apparently all of the mercury, and between 20 and 40 percent of the other metals."

In addition to tap water, they cite two other sources of heavy metals in domestic wastewater: food materials and non-food commodities. Food materials contributed to the heavy metal loading significantly, although the two sites differed in manner and extent. They estimate, "Approximately one-half of the cadmium, copper and zinc found in the wastewater (at Oakdale) comes from foodstuffs, along with one-third of the chromium and mercury, and a smaller proportion of the lead and nickel. At Hanover Park, nearly all the cadmium in the wastewater can be accounted for by the food intake, but under 20% of the other metals have this origin." (Gurnham et al., 1979).

Thus we can see that for most of the heavy metals, the combination of tapwater and food commodities account for a major percentage of the metals found in the residential sewage. Non-food commodities did contribute to the heavy metals discharged to the sewer system, although a large portion appeared to originate from a relatively small number of items. (See Tables 24 and 25.) They name the following as being the principal sources: powder laundry soap, bath soap, fabric softener, liquid bleach, toilet and facial tissues, and liquid dish detergent.

The study by Gurnham et al. (1979) also revealed that a discrepancy exists between the concentration values that they found in their sampling program and the much higher values that had previously been attributed to residential sources in the literature. Table 26 illustrates these differences; the data from MSDGC were included for specific comparisons, as both the Oakdale and Hanover Park sampling neighborhoods are in the Chicago urban area. The investigators attributed the discrepancy to sampling procedures. The literature values were usually taken at influent points to sewage treatment plants rather than "in line" on residential flows, with the resulting uncertainty as to undefined sources contributing to the loading (Gurnham et al., 1979).

Table 23.

ANALYSIS OF HOUSEHOLD CONTRIBUTION OF METALS TO WASTEWATER.
Values are average concentrations in ug/l (ppb).
(Gurnham et al., 1979).

	Two Residential Areas Sampled					
	Oakdale			Hanover Park		
Parameter	Sewage	Tap	Difference	Sewage	Tap	Difference
Cadmium	2.2	1.3	0.9	1.1	0.2	0.9
Chromium	6.0	2.8	3.2	4.7	1.7	3.0
Copper	10.8	3.7	7.1	90	36	54
Lead	10.5	4.8	5.7	26	9.0	17
Mercury	0.2	0.2	0.0	0.4	0.4	0.0
Nickel	21	10	11	18	14	4
Zinc	34	31	3	219	37	162

Table 24.

HEAVY METAL CONTRIBUTIONS FROM HOUSEHOLD PRODUCTS LIKELY TO ENTER DOMESTIC SEWAGE.
Values are given as ug/capita/day.
(Gurnham et al., 1979.)

	Metal Contribution						
	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Mouthwash	0.3	2.1	1.7	1.2	0	69.9	2.9
Toothpaste	4.2	11.3	26.4	29.3	0.1	326.8	17.3
Toilet Tissue	4.5	21.9	3.8	23.9	0.6	108	31.3
Bath Soap	18.3	267	104.7	141.2	6.3	4404.3	117.9
Waterless Hand Soap	0	0.1	0	0.1	0	0.5	0.2
Shampoo	0.2	4.0	1.3	0.6	0	32.1	44.9
Creme Rinse	0.11	1.8	1.0	0.5	0	15.9	1.2
Baby & Bath Oil	0.4	6.5	2.3	0.6	0	80	7.8
Skin Lotion	0.4	5.7	1.2	0.7	0	86.8	6.2
Acne Lotion	0	0	0	0	0	0.36	0
Shave Creme	0.1	1.8	0.7	0.2	0.1	18.7	1.2
Pre-shave Lotion	0	0.1	0	0.1	0	0.6	0.5
Depilatory Creme	0.1	0.1	0.1	0.4	0	1.2	0.2
Liquid Dish Detergent	4.5	22.2	32.8	2.0	0	536.6	5.6
Dishwasher Detergent	1.3	13.1	7.3	2.8	0	2363.7	12.8
Powder Kitchen Cleaner	0.6	11.9	13.4	3.0	0	1491.7	312
Steelwool Soap Pads	1.0	1.1	5.2	0.1	0.1	15	0.8
Toilet Bowl Cleaner	0.3	6.3	4.5	0.9	0	283.9	30.8
Drain Opener	0.1	0.8	0.1	0	0	10.1	0
Liquid Laundry Soap	2.3	7.9	6.6	2.7	0	97.6	14.6
Powder Laundry Soap	26.6	221.9	249.4	31.3	0.3	11523.6	94.5
Fabric Softener	7.4	10.1	9.3	24.9	0	95.8	4.3
Liquid Cold Water Wash	0	0.1	0	0.01	0	0.5	0.1
Liquid Bleach	3.6	10.7	5	2.0	0	519.6	8.1
Powder Bleach	2.5	22.7	24.3	1.5	0	1162	11.2
Liquid Household Cleaner	1.7	7.6	3.4	2.1	0	92.4	10
Household Powder Cleaner	0.7	3.2	3.2	0.1	0	104.6	1.8
Liquid Dye	0	0.3	2.3	0	0	6.7	0.4
TOTALS	81	662	510	272	7.5	23449	738

Table 25.

HEAVY METAL CONTRIBUTIONS FROM HOUSEHOLD PRODUCTS UNLIKELY TO ENTER DOMESTIC SEWAGE.

Values are given as ug/capita/day.
(Gurnham et al., 1979.)

	Metal Loading						
	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Facial Tissue	2.6	21.8	24.3	10.7	1.2	275.2	66.1
Cotton Balls	0.2	0.7	0.6	0.1	0	11.7	3.4
Disposable Diapers	0.3	2.6	0.8	1.2	0.3	49.3	4.6
Glass Cleaner	0.1	0.2	1.7	0.1	0	6.4	0.3
Household Disinfectants	0.1	0.2	0	0.1	0	5.6	2.0
Furniture Polish	0	0.2	0.1	0	0	1.4	0.3
Silver Polish	0.1	0.6	0.2	0.1	0	42.8	1.0
Floor Finish	0.4	1.1	0.5	0	0	5.4	0.3
Motor Oil	0.5	3.1	0.6	0.4	0	53.0	1166.8
Transmission Fluid	0.1	0.5	0.2	0.1	0	4.7	6.1
Auto Wax	0	0.5	0.2	0.1	0	5.8	0.6
Paint	0	0.3	0.1	0.8	0	4.2	10.3
Paint Thinner	0.1	0.2	0.6	0.1	0	2.5	0

Table 26.

COMPARISON OF VALUES FOR HEAVY METAL LEVELS IN RESIDENTIAL WASTEWATER.

Values are concentrations in ug/l (ppb). (Gurnham et al., 1979.)

			Gurnham sites	
	Literature Average	MSDGC*	Oakdale	Hanover Park
Cadmium	16	45	2	1
Chromium	69	90	6	1
Copper	159	125	11	90
Lead	68	65	10	26
Mercury	3	0.2	0.2	0.4
Nickel	67	150	21	18
Zinc	240	125	34	219

* Metropolitan Sanitary District of Greater Chicago.

In summary, mass balance charts (Tables 27 a and b) for the two neighborhoods studied by Gurnham et al. give an indication of the relative importance of consumer products as sources of metals in domestic wastewater. As these charts show, consumer products tend to supply some, but not a major part (except for nickel) of the heavy metals in residential sewage. (The calculations of nickel input from products, however, exceeded by a factor of four the actual flows observed.)

(b) Trace Organic Compounds. Very little is known about organic compounds in residential wastewater. The report by Levins et al. (1979), "Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants," is the most definitive work to date on sources of trace organics. Some of their results and conclusions follow:

- In their literature review, references to 31 of the 111 organic priority pollutants were found in residential sources. Of these 31, the compounds found in the highest concentrations were chloroform, other halo-methanes, ethyl benzene, and toluene.
- In their sampling study of four drainage basins (in Cincinnati, St. Louis, Atlanta and Hartford), relatively few organic pollutants were found from all residential sources. Most of these were at low concentration levels.
- Out of the 111 organic priority pollutants, 43 were observed in non-industrial sources; 64 were never detected, and an additional 20 were detected less than 10% of the time.
- Indices used to calculate relative strengths of the various sources clearly reflect the impact of industrialization. However, they also show the dominant role played by residential and commercial sources for some pollutants, such as chloroform, benzene, pentachlorophenol, diethyl phthalate, di-n-butyl phthalate, and others.
- Pollutants from residential sources are more often observed on weekends than on weekdays.
- Old residential sources contribute higher levels of pollutants than new residential sources.

Table 28 presents the organic pollutants found in residential wastewater. It should be noted that, in this case, "residential" means that at least 95% of the flow was from domestic sources. The "average for all sites" refers to the mean of all the residential sites that Levins et al. sampled, including some sites that were less than 95% domestic flow (though all were at least 70% residential). As can be seen from this table, most of the sites had low concentrations or none of the organic pollutants;

Table 27.

MASS FLOWS OF HEAVY METALS IN TWO RESIDENTIAL WASTEWATERS: A. OAKDALE AND B. HANOVER PARK.

Values are loadings in ug/capita/day. (Gurnham et al., 1979)

	Calculated Flows from Source Analysis				Actual Sewage
Metal	Tapwater	Foods	Commodities	Totals	
A. Oakdale Neighborhood:					
Cd	447	482	81	1,040	806
Cr	1,060	364	662	2,086	2,172
Cu	1,397	2,909	510	4,816	3,875
Pb	1,814	331	272	2,417	3,763
Hg	64	27	7.5	98	86
Ni	3,749	699	23,449	27,897	7,505
Zn	11,691	11,953	738	24,382	12,305
B. Hanover Park neighborhood:					
Cd	81	482	81	644	410
Cr	629	364	662	1,655	1,705
Cu	13,763	2,909	510	17,175	32,561
Pb	3,409	331	272	4,012	9,510
Hg	155	27	7.5	190	151
Ni	5,431	699	23,449	29,579	6,530
Zn	12,716	11,953	738	25,407	78,758

Table 28.
SUMMARY OF CONCENTRATIONS OF ORGANIC POLLUTANTS IN RESIDENTIAL WASTEWATER FROM FOUR URBAN AREAS.
The basins sampled were at least 95% domestic input. Values are concentrations in ug/l(ppb).
(Levins et al., 1979.)

	Cincinnati, OH. #1	St. Louis, MO. #1	St. Louis, MO #2	St. Louis, MO #3	Atlanta, GA #1	Hartford, CT #1	Hartford, CT #2	Hartford, CT #3	Average for All Sites	(Standard Deviation)
Chloroform	1.5	2.9	3.4	3.3	4.7	4.6	.0	2.7	3.0	(.9)
1,2-Dichloroethane	.0	.0	.0	.7	.0	.0	.0	.0	.1	(.1)
1,1,1-Trichloroethane	.0	4.6	.6	1.2	.0	.9	.0	24.2	2.3	(2.8)
Bromodichloromethane	.0	.0	.0	.3	.0	.0	.0	.0	.0	(.1)
Trichloroethylene	.0	.0	1.6	.3	.0	.0	.0	.0	.4	(.5)
Benzene	.0	.7	.2	1.5	.0	.0	.0	.0	.2	(.4)
Dibromochloromethane	.0	.0	.0	.3	.0	.0	.0	.0	.0	(.0)
1,1,2,2-Tetrachloroethylene	.4	21.3	15.0	15.9	2.0	1.6	.3	.7	6.3	(7.6)
Toluene	.5	2.1	5.4	11.9	.5	.0	.0	.0	2.6	(2.7)
Chlorobenzene	.0	.0	.0	.3	.0	.0	.0	.0	.1	(.1)
Ethyl Benzene	.2	.0	.0	3.4	.3	.0	.0	.0	.4	(.5)
Phenol	1.5	2.1	15.4	6.2	5.1	.0	.0	.0	5.8	(5.6)
2,4-Dimethylphenol	.0	.0	2.1	.0	3.7	.0	.0	.0	.7	(.8)
Pentachlorophenol	.0	.0	.0	.0	.0	.0	.0	.0	1.2	(2.4)
Dichlorobenzenes	.0	.0	12.8	20.3	.0	.0	.0	.0	2.8	(5.5)
Naphthalene	.0	.0	19.2	.0	.0		.0	.0	2.1	(2.9)
Diethyl Phthalate	16.8	13.3	11.3	3.4	.0	.0	.0	15.0	9.8	(11.6)
Di-N-Butyl Phthalate	18.6	8.5	23.8	7.1	5.0	.0	14.5	3.2	9.0	(6.5)
Butyl Benzyl Phthalate	7.5	13.2	11.9	24.7	.0	.0	.0	8.3	6.8	(7.5)
Bis (2-Ethyl-Hexyl) Phthalate	7.4	2.9	.0	46.3	.0	.0	.0	.0	6.8	(8.1)

the exceptions are the phthalates (perhaps from plastic piping) and a few of the halogenated hydrocarbons (probably from chlorinated water supply).

As mentioned previously, Metro's Toxicant Pretreatment Planning Study (TPPS) is currently investigating sources of toxic pollutants to the local sewage treatment system. Because the data are not yet complete, any conclusions that could be drawn from the currently available information must be tentative at best. However, some of the interim findings are as follows:

- Forty-three pollutants have been observed from all residential, commercial and industrial sources; 20 of these are found in residential sources, and an equal number in commercial. A total of 28 are seen in industrial sources.
- Each source tends to have its own priority pollutants. Those that are common to all three are: phenol, dichlorobenzene, naphthalene, phthalates and solvents.
- The average concentration of priority pollutants is much greater for the industrial sources than for the residential; residential sources are greater than or equal to commercial sources.

In the four residential sites sampled, the TPPS has found between 12 and 15 organic pollutants in the wastewater. These are mostly phthalate esters, with a few prominent solvents. However, the TPPS research team has not yet determined the residential percentage of the sample basins, which makes it more difficult to determine if the results accurately reflect domestic contribution to the toxic load.

The most frequently seen organic pollutants in the residential basins, and their concentration ranges, are:

Phenol:	13-22 ppb
Naphthalene:	1.4-2.0 ppb
Diethyl phthalate:	5.3-15 ppb
Di-n-butyl phthalate:	30-35 ppb
Butyl benzyl phthalate:	21-39 ppb
Di-n-octyl phthalate:	7.6-27 ppb
Chloroform:	0.7-5.3 ppb
Benzene:	2.3-2.4 ppb
Toluene:	4.3-5.4 ppb
Tetrachloroethylene: (perchloroethylene)	2.6-100 ppb

Some of the organic chemicals found during the TPPS sampling, such as tetrachloroethylene and phenol, can be found in consumer products. It is impossible to say with certainty whether or not their presence is due to the disposal of toxic consumer products, although such a source is certainly a possibility. Some of the other chemicals seen have unrelated sources: the chloroform is almost certainly a result of chlorination of the water supply, while the phthalates may be coming from plastic piping.

6. Summary

Although the studies that have been cited only begin to explore domestic sources of toxicants, they do shed some light on the household hazardous waste problem. The routes for disposal of these substances are quite limited for the average householder. Of those routes that are available, little is known about the fate of the chemicals that are landfilled. It appears that some chemicals, when disposed with the wastewater, are not completely removed by on-site treatment systems.

Those chemicals which are disposed of via the sewerage system do consistently show up in sewage and sometimes in surprisingly high concentrations. There are certain substances which appear to be ubiquitous, being detected in household wastewater in all parts of the country. These include heavy metals, solvents (e.g., tetrachloroethylene), phthalates and some phenols. Although the frequency and concentration of these chemicals is less for domestic sources than for commercial and industrial, they nevertheless contribute to the toxic waste stream.

E. ANALYSIS OF THE PROBLEM

In the preceeding sections, the various perspectives on the household hazardous waste problem are examined. Toxic residential wastes may be considered a problem for the following reasons:

- They are currently unregulated under federal and Washington State hazardous waste disposal rules and, therefore, there is no direct control over their entry into the environment.
- Labeling practices in most cases do not provide sufficient information for the consumer to make informed disposal decisions.
- While some local regulations cover such wastes, they are rarely enforced.
- Analysis of products and their contents reveals that these products contain hazardous substances which may have serious adverse effects on human health or the environment through their use or disposal. In particular, pesticides, organic solvents in paint and cleaning products, and motor oil present the greatest threats to the environment.

- These products are used and disposed of in quantities that are cumulatively large enough to cause concern, despite the fact that they originate from numerous small, decentralized sources.

These reasons for concern lead inevitably to a central issue: if a problem exists, what should be done about it? How should citizens dispose properly of their toxic household wastes? From what is known at this time, small quantities of toxic products are disposed of in the trash can, down the toilet, down the street gutter or storm drain, in a hole in the backyard, or in some other similar, possibly undesirable manner. Local, state and federal agencies, private businesses and public interest groups have become increasingly concerned with the disposal of these small amounts of toxicants. Many of these groups have had some type of existing policy on disposal (e.g. to wrap the product in newspaper and throw it away, or to bury it), but these policies have often been different and have left the consumer at a loss to determine which is best. Each agency or group also has particular concerns. Metro, for example, would like to see a reduction in the number of toxicants entering the sewerage system and areawide waters. Seattle and King County solid waste managers would like to see a reduction in toxicants entering the landfills. Thus, there has been another problem within the problem addressed above: the lack of straight-forward, consistent directions for the concerned citizens in the Seattle/King County area for disposal of their diverse household wastes.

The procedure that was used in this project to develop answers to the questions involved determining the various disposal options available and then evaluating them to determine the best mix for the local area. There were three stages to this process:

1. Review of existing disposal practices and current regulations which are applicable.

2. Determination of which chemicals or classes of chemicals can be disposed of via the sewerage system, sanitary landfill, hazardous waste site, or other facilities and non-facility methods.

3. Determination of various collection system options which might be feasible in the region for the collection of wastes which are determined to be unacceptable for normal disposal and which must be specially treated, reprocessed or stored in order to prevent water pollution or health problems.

Stages one and two have generally been outlined in the preceeding chapter (II). Stage three consisted of a pilot study and development of subsequent collection systems and recommendations described in Sections III and IV, which follow.

SECTION III

SOLUTIONS TO THE HOUSEHOLD HAZARDOUS WASTE DISPOSAL PROBLEM

A. LOCAL ACTIONS: PILOT STUDY

1. Introduction

One of the objectives of the Household Hazardous Waste Disposal Project, as outlined in the project's work plan (Metro, 1981), was "...to evaluate (the) effectiveness in this local region (the Seattle area) of one or more disposal options in a pilot study." The study, within a short-term, low-budget planning project, was designed to test possible components of a regional plan before they became final recommendations. In order to develop a balanced and realistic recommendation, we needed to check general public opinion and actions to find out: 1) what average citizens think about the issue of household hazardous waste, 2) what they say they would be willing to do about it, and 3) if they would actually do what they said they would do. As the study progressed, we added one more question: 4) why they did or did not do what they said they would do. The Household Hazardous Waste Disposal Committee spent many months designing the pilot study to address these issues as efficiently as possible.

In order to run a test in a portion of the metropolitan area's total population, one or more representative neighborhoods had to be selected. Knowledge of the sample population's demographics and attitudes and how they compare with the metropolitan area's demographics and attitudes were critical to the success of the test. The pilot study design was based on the following assumption: if we know how opinions in the target neighborhood compare to the regional population, we will be able to extrapolate how the region will act, based upon the response of the target neighborhood to our test.

After reviewing census tract information, the target neighborhood was selected based upon three criteria: 1) median income slightly above Seattle median, 2) median housing value slightly above Seattle median, and 3) homeowner occupancy 70% or greater. The committee used these criteria to select residents with slightly higher than average income levels who owned their homes, assuming they would be most likely to use pesticides, change their car oil, paint their houses, etc. The committee was consciously "stacking the deck" in favor of a higher participation rate. The reasoning was that if this neighborhood didn't respond, other neighborhoods would be even less likely to participate.

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The pilot study was composed of three parts:

(a) An initial or "before" survey that compared the neighborhood to the region as a whole on the three criteria discussed above, and on attitudes toward household wastes;

(b) A short waste collection project in the study neighborhood; and

(c) A follow-up or "after" survey to help evaluate and interpret the collection project results.

The initial survey was conducted by telephone using randomly-selected numbers in two distinct groups: 300 residents from the Seattle/King County area and 214 residents from the target neighborhood. Questions addressed basic demographic parameters, awareness of and attitudes about hazardous substances in consumer products, and willingness to participate in alternate disposal practices.

The waste collection project was conducted in February 1982, in the test neighborhood. Three types of wastes were collected -- used motor oil, old or waste pesticides and waste solvents. The oil was collected at a number of service stations in the area and the pesticides and solvents at a local fire station.

The follow-up survey, similar to the initial survey, was conducted only in the test neighborhood. Questions addressed awareness of the pilot study, reasons for participating or not participating and attitudes on future programs.

An in-depth analysis of the pilot project and surveys can be found in Part C of this report series, entitled Public Opinions and Actions.

2. Public Opinion Surveys

What did the surveys tell about the thoughts and opinions of the general public concerning household hazardous waste? They determined that the people are knowledgeable about the presence of products that can be considered toxic or hazardous in their houses. This knowledge appears to be based on acute poisoning concerns rather than an awareness of their effects in the environment. Products with high human hazard but low environmental damage potential (e.g., drain cleaners) were rated as "most hazardous" while those which are more of a threat to the environment than to the individual (e.g., motor oil) were ranked the lowest hazard. This finding is in contrast to the public's stated expressions of concern, however. When asked whether their concern about household hazardous waste was based primarily on environmental or human health reasons, most people stated that it was because of environmental threats.

These findings have important implications for any educational programs on the topic. Given that the public already has a general awareness of the subject, educational materials should emphasize the environmental hazard of household product use or disposal, and explain the difference between human health and environmental concerns.

The surveys determined that the presence of toxic/hazardous household products named in the questionnaire were found in more than half the homes. These were, in descending order of frequency: household cleaners, auto or furniture polishes, paints or thinners, motor oil, pesticides, fertilizers, and chemical drain openers. Despite the ubiquitous nature of these products, however, people didn't seem to dispose of them frequently. Only 28% said that they had disposed of any of the ten products (the above, plus week killers, antifreeze and wood preservatives) in the last year. This finding was further reinforced in the second survey, when only 10% of the respondents said they had something in their homes they considered hazardous that they wanted to dispose of.

Finally, we also learned from the surveys that the public is concerned about the household hazardous waste disposal issue; 66% of the first and 55% of the second survey expressed some or high concern for the subject.

3. Pilot Collection Project

The hazardous waste collection project of the Pilot Study was designed as a simple action/no action test in the selected neighborhood. It provided with information about household hazardous wastes and a reasonably convenient collection/disposal site, how many people out of a defined test population would respond? The initial survey found that 88% of the people questioned said that they would "make an effort" to dispose of toxic products into a nearby community waste disposal center. Of those 88%, 81% said they would use a "permanent neighborhood collection site," 77% would use a "neighborhood 'dump day'," 67% would use a "free service that would come to people's homes," and 66% would use a "neighborhood oil recycling collection site."

A neighborhood of 4,000 households in Seattle was blanketed with information about household hazardous wastes and given the opportunity to dispose of used motor oil, pesticides and solvents safely and conveniently during a three-week period. Automotive wastes (oil, brake and transmission fluids) were accepted at six local service stations. Waste pesticides and solvents were accepted at Fire Station No. 24 seven days a week. Arrangements were made to identify, catalogue, pack in barrels and dispose of all wastes that were brought in during the short test period. The information packet also provided an option to have wastes picked up at home by calling Metro.

All 4,000 households in the test area -- portions of the Blue Ridge, Crown Hill, and Broadview neighborhoods -- were notified of the project by a flyer and brochure delivered to their front doors. This distribution technique was aimed at ensuring that everyone in the test area was given the opportunity to learn about the project. In addition to the door-to-door flyers, the information campaign included posters displayed at area commercial outlets, schools, churches and branch libraries; notices in community newsletters; and presentations and flyers given to about 300 school children at three elementary schools. Mass media, such as radio, TV and newspapers, could not be used because they are not selective. In order to effectively manage the wastes, we needed to control the volumes, and this was most easily done by limiting the information distribution.

The actual collection and waste handling procedure was quite complex and is described in detail in Public Opinions and Actions. Both the federal Environmental Protection Agency and Washington State Department of Ecology issued determinations on the applicability of federal and state hazardous waste regulations to the pilot study. Both agencies indicated that household wastes are excluded from regulations.

The three-week test ran from February 7 to February 28, 1982, during a cold, wet period in Seattle's winter. Fifteen people brought household hazardous wastes to the Fire Station and approximately forty people (based on service station estimates) recycled used oil. In addition, one person requested waste pick-up by telephone.

Two and one-quarter 55-gallon drums were filled at the Fire Station; waste pesticides filled two drums (with packing material), while waste solvents accounted for only a portion of another drum. A total of approximately 90 pounds of solid pesticides were turned in plus six gallons of liquids. Only three quarts of waste solvents were collected. No estimates of volume could be obtained for the recycled oil.

Table 29 presents a summary of the types of pesticides collected. The 86 individual containers of waste pesticide turned in are arranged by frequency of occurrence. The most common pesticides seen, in descending order, were: chlordane, the 2,4-D/2,4,5-T/-Silvex group, DDT, and the various arsenicals.

The second survey determined that less than half of the test population were aware of the pilot study despite door-to-door leafletting, etc. Most people who were aware of the study could give no specific reason for not participating, while 20% said they had nothing to dispose of. Some factors that could have contributed to this low response include:

Table 29. WASTE PESTICIDES TURNED IN DURING COLLECTION PROJECT.

The following pesticides turned in by the 15 project participants are arranged in order by frequency of occurrence. Items with asterisks (*) in quantity column were in mixtures with other pesticides in the list.

Pesticide	Frequency (# of individual items)	Quantity (solid/ liquid)	Average Estimated Age (years)
Chlordane	13	5 lbs/6 pts	8
2,4-D/2,4,5-T/Silvex	12	28.5 lbs/4.5 pts	8
DDT	10	6 lbs/10 pts	9
Arsenicals -arsenic trioxide -lead, calcium, and sodium arsenate	7	15 lbs/1.1 pts	15
Diazinon®	4	3 lbs/1.5 pts	7
Lindane	4	0.5 lb/5 pts	5
Carbaryl	4	1.6 lb*/1 pt*	5
Sulfur -sulfur dust -polysulfides	3	2 lbs/4 pts	9
Mercuric Compounds -phenyl mercury -mercuric iodide	3	0.25 lbs*/ 3 pts*	5
Malathion	3	0.7 lb*/1 pt*	6
Captan	2	4 lbs*	5

Table 29. WASTE PESTICIDES TURNED IN DURING COLLECTION PROJECT (Continued)

Pesticide	Frequency (# of individual items)	Quantity (solid/ liquid)	Average Estimated Age (years)
Nitrophenols	2	3 lbs	8
Metaldehyde	2	0.75 lb*	5
Pyrethrins	2	1 lb*	5
Cyanide Salts	1	10.5 lbs	40
Pentachlorophenol	1	2 pts	-
Warfarin	1	1 lb	-
Aldrin	1	1 pt	2
Naled	1	4 pts*	5
Toxaphene	1	2 pts	5
Diuron	1	1 lb	-
Rotenone	1	0.5 lb*	-
DDD	1	0.5 lb*	-
Maneb	1	0.6 lb*	-
Folpet	1	0.3 pt	10
Trichlorfon	1	0.3 pt*	-
Methyl-Demeton	1	0.3 pt*	-

- Time of year of study (February);
- Information transfer methods (e.g., little use of mass media);
- Choice of neighborhood; and
- General public inertia to new programs.

B. LOCAL SOLUTIONS: REGIONAL PLAN

1. Conclusions from Pilot Study

What did the pilot study mean in terms of a regional control plan for household quantities of toxicants? We found that, while people are concerned about the issue, there does not appear to be a large need for a massive collection network (i.e., daily collection of wide variety of toxic products at numerous collection sites). In particular, it appears that there is not a need for solvent collection. Some of the other hazardous household products, such as cleaners, antifreeze and paint, were determined to be not environmentally hazardous enough to warrant a collection program.

We concluded that pesticides and motor oil are the two classes of toxic products for which a collection program should be provided in this area. Banned pesticides exist in substantial amounts in homes. Using gross calculations, we can estimate that as much as 135,000 pounds (300 barrels) of banned household pesticides may be sitting in people's homes in the Seattle/King County area alone. Because these products are no longer available for sale and thus the supply is finite, we believe that the preferable collection system would be a "sweep out" method, such as a regional dump day, in conjunction with an on-going but not as widespread or convenient collection service, such as the use of the five Health Department offices in the County (more on that later).

The public does not seem to regularly dispose of large quantities of most household hazardous waste, except used motor oil. Approximately 1.4 million gallons of waste motor oil are produced and could be recycled in King County alone each year. Studies have shown that, while most people know that oil can be recycled, only a very small percentage know how or where to do it. Thus, an extensive promotion of oil recycling awareness is warranted and greatly needed.

In general, we believe that, given the level of interest and expressed willingness to change habits, increased public education on the Household Hazardous Waste Disposal issue would be worthwhile and well-accepted.

2. Final Plan

As described in Section I, the goal of the Household Hazardous Waste Disposal project has been to "reduce the quantity of toxic substances entering the areawide waters from residential activities by providing a plan for the disposal of small quantities of toxicant-containing household wastes" (Metro, 1981). The Final Plan, as it has been developed by the HHWD Committee, is composed of six parts:

(a) Product Disposal Recommendations;

(b) Health Department/ChemPro collection sites;

(c) "Dump Day" collection system;

(d) Oil Recycling promotion;

(e) Public education; and

(f) HHWD Committee.

(a) Product Disposal Recommendations. The Product Disposal Recommendations (PDRs) are the core of the control plan. They provide the answers to the public's questions on what to do with their wastes. The HHWD Committee formulated these recommendations through an extensive process of research, internal review and consensus decision-making. Once the committee members had worked out all the "bugs" (and this process took about five months), the Recommendations underwent review within the represented organizations. Committee members worked within the existing framework of their organizations or agencies to receive endorsements. This was done by having the appropriate official of each represented agency, business or organization sign an interagency agreement which stated:

> "We agree that the Product Disposal Recommendations as developed by the Household Hazardous Waste Disposal Committee are the preferred means at this time by which citizens should dispose of their toxic domestic waste. Furthermore, we agree to promote these Recommendations in our contact with the public."

Table 30 provides a list of those agencies and organizations which have endorsed the PDR's. Member organizations who do not receive citizen inquiries on a regular basis or are outside the recommendation's jurisdiction (e.g., Tacoma-Pierce County Health Department, Chem-Security Systems, Inc.) were not asked to provide formal endorsments.

Table 30. PRODUCT DISPOSAL RECOMMENDATION ENDORSEMENTS.

The "Disposal Recommendations" (Appendix B) were drafted by the HHWD Committee and have been endorsed by the following member organizations and agencies.

- Chemical Processors, Inc.
- King County Solid Waste Division
- Municipality of Metropolitan Seattle (Metro)
- Poison Control Center (Children's Orthopedic Hospital Medical Center)
- Puget Consumers Co-op, Inc. (Product Information Committee)
- Seattle Audubon Society
- Seattle Fire Department
- Seattle/King County Health Department
- University of Washington, Department of Environmental Health
- U.S. Consumer Product Safety Commission
- U.S. Environmental Protection Agency--Region 10
- Washington Environmental Council
- Washington State Department of Ecology
- Washington State Office of Environmental Education
- Western Washington Toxics Coalition

The PDR's were designed to be used by agencies and organizations who receive disposal inquiries, not directly by the general public. Because many of the recommendations are complicated and there may not be one simple answer, inquiries are handled on a case-by-case basis wherein the call recipient needs to evaluate the information and give recommendations using knowledge of the available options and best judgement.

Appendix B contains a modified version of the Product Disposal Recommendations suitable for general use. The straightforward recommendations are included as is, while those that involve more complicated responses are replaced with advice to call Metro Toxicant Control. Appendix B also includes a copy of the response form used as a partial guide for answering questions. The complete PDR's, along with other information that will be useful in answering questions, has been compiled for easy reference in the Directory, which is Report E of the HHWD series. The Directory is only available to organizations who receive citizen inquiries.

(b) Health Department/ChemPro Collection Sites. In response to the special need for collection of unwanted or banned pesticides that was shown by the pilot project, a collection program was set up. In cooperation with Chemical Processors, Inc., the Seattle/-King County Health Department now accepts pesticides at their district offices. Figure 2 shows a reduced version of the flyer which the Health Department distributes. It explains the specifics of the program. To handle the wastes, the Health Department has developed recommended procedures for different pesticides, which are described in Appendix C.

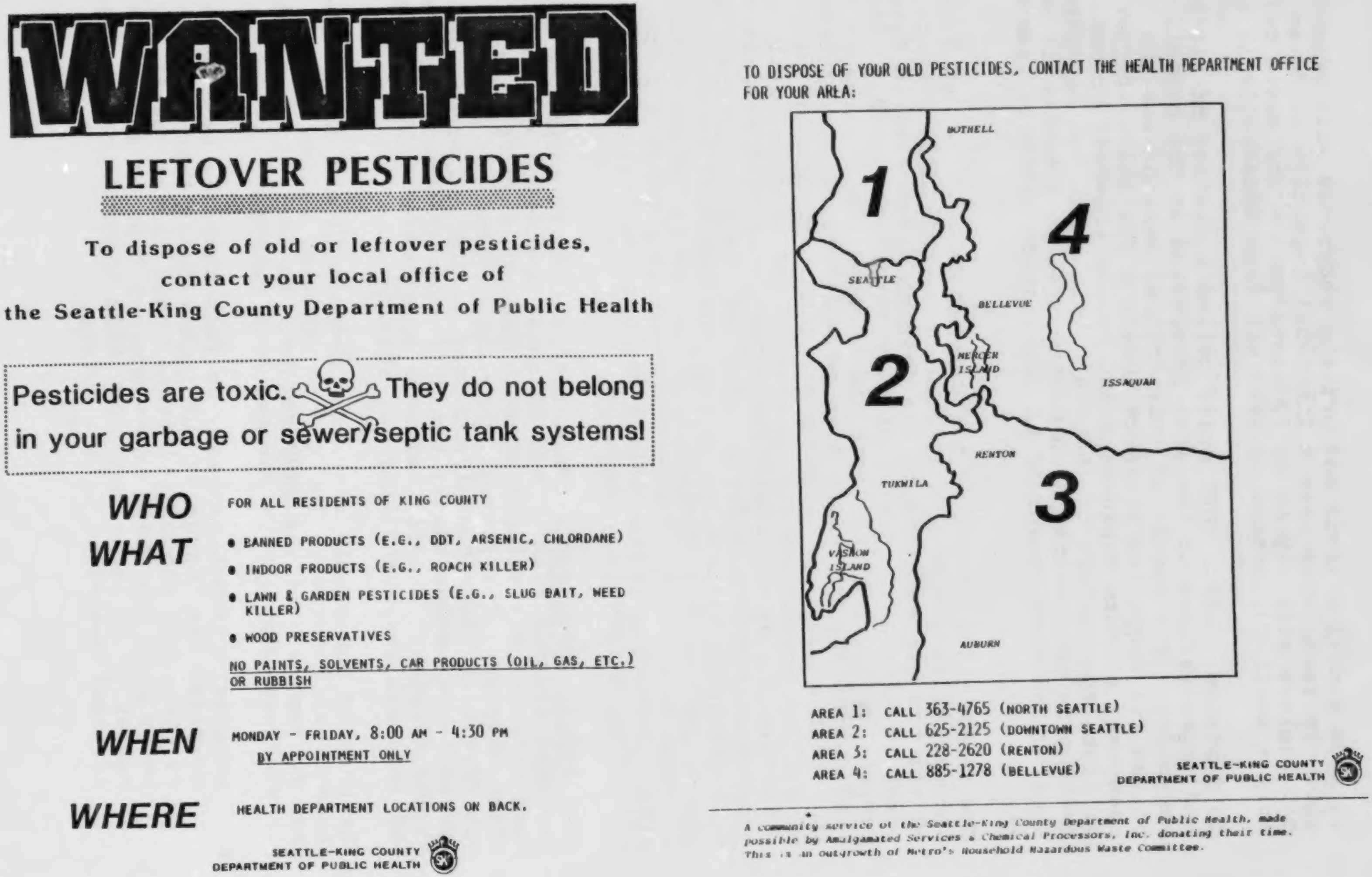
(c) "Dump Day" Collection System. While the Health Department/ChemPro collection program is stable and on-going, we determined through the pilot study that it needs to be supplemented by a "sweep-out" program. This would consist of one or two days per year, called "Dump Days," held on a weekend in the spring or fall, when old or banned pesticides would be collected at numerous temporary sites around the Seattle/King County area. A yearly dump day would provide two benefits that the ChemPro/Health Department program doesn't offer:

- It would be more convenient. The Health Department sites are open only during business hours; the Dump Day would enable working persons to dispose of their unwanted pesticides safely.

- The increased publicity and media attention focused on an event of this sort would reach all members of the general public in an effective manner.

(d) Oil Recycling Promotion. Through our research both in the literature and in the local area, a clear fact emerged: more public education on oil recyclng is needed. A superb collection system already exists. Most full-service gas stations, as well

Figure 2. CHEM PRO/HEALTH DEPARTMENT COLLECTION SYSTEM FLYER


1
2
3
4
BOTHELL
SEATTLE
BELLEVUE
MERCER ISLAND
ISSAQUAH
RENTON
TUKWILA
VASHON ISLAND
AUBURN

WANTED

LEFTOVER PESTICIDES

To dispose of old or leftover pesticides, contact your local office of the Seattle-King County Department of Public Health

Pesticides are toxic. They do not belong in your garbage or sewer/septic tank systems!

WHO FOR ALL RESIDENTS OF KING COUNTY

WHAT
- BANNED PRODUCTS (E.G., DDT, ARSENIC, CHLORDANE)
- INDOOR PRODUCTS (E.G., ROACH KILLER)
- LAWN & GARDEN PESTICIDES (E.G., SLUG BAIT, WEED KILLER)
- WOOD PRESERVATIVES

NO PAINTS, SOLVENTS, CAR PRODUCTS (OIL, GAS, ETC.) OR RUBBISH

WHEN MONDAY - FRIDAY, 8:00 AM - 4:30 PM
BY APPOINTMENT ONLY

WHERE HEALTH DEPARTMENT LOCATIONS ON BACK.

SEATTLE-KING COUNTY
DEPARTMENT OF PUBLIC HEALTH

TO DISPOSE OF YOUR OLD PESTICIDES, CONTACT THE HEALTH DEPARTMENT OFFICE FOR YOUR AREA:

AREA 1: CALL 363-4765 (NORTH SEATTLE)
AREA 2: CALL 625-2125 (DOWNTOWN SEATTLE)
AREA 3: CALL 228-2620 (RENTON)
AREA 4: CALL 885-1278 (BELLEVUE)

SEATTLE-KING COUNTY
DEPARTMENT OF PUBLIC HEALTH

A community service of the Seattle-King County Department of Public Health, made possible by Amalgamated Services & Chemical Processors, Inc. donating their time. This is an outgrowth of Metro's Household Hazardous Waste Committee.

as some retail outlets and private recyclers will accept used oil. In fact, they have a financial incentive to do so because oil haulers will pay 10 to 20 cents/gallon for waste oil. Yet only a small percentage of used oil from households is recycled.

In September, 1981, HHWD staff called a meeting of all persons and organizations in the area interested in the promotion of oil recycling. The result of this initial meeting was the formation of the Oil Recycling Alliance (ORA), a coalition of government agencies, private businesses and public interest groups. Table 31 lists the members of the ORA. This group has promoted oil recycling in the Seattle/King County area in a number of ways, including the development of an information brochure (see Figure 3).

The other major thrust of the ORA has been to set up a pilot demonstration project in a local area. Alliance members contacted all the gas stations in the Juanita Creek area in King County north of Kirkland. Twelve station managers agreed to display "We recycle used oil here" signs and monitor the volumes of oil recycled during the project. A large media campaign was then begun and other educational efforts continue. Monitoring of the volume of oil collected, and any changes in the pattern, will show the effectiveness of oil recycling promotion. This demonstration project will continue for a year. If the pilot project produces an increase in citizen recycling, the ORA will develop an educational package of recycling tips for use by garden clubs, industries or other local groups that want to perform a community service. Community organizations may also be able to make money conducting a recycling campaign.

(e) Public Education. Education is a vital component of our regional control plan. Safe disposal practices will only happen when citizens are willing to make the extra effort that they often require. The prevalent public attitude of out-of-sight, out-of-mind is detrimental not only to the proper management of household hazardous waste, but to issues of sewage treatment, sludge disposal, landfill siting, local water pollution control and personal responsibility for actions.

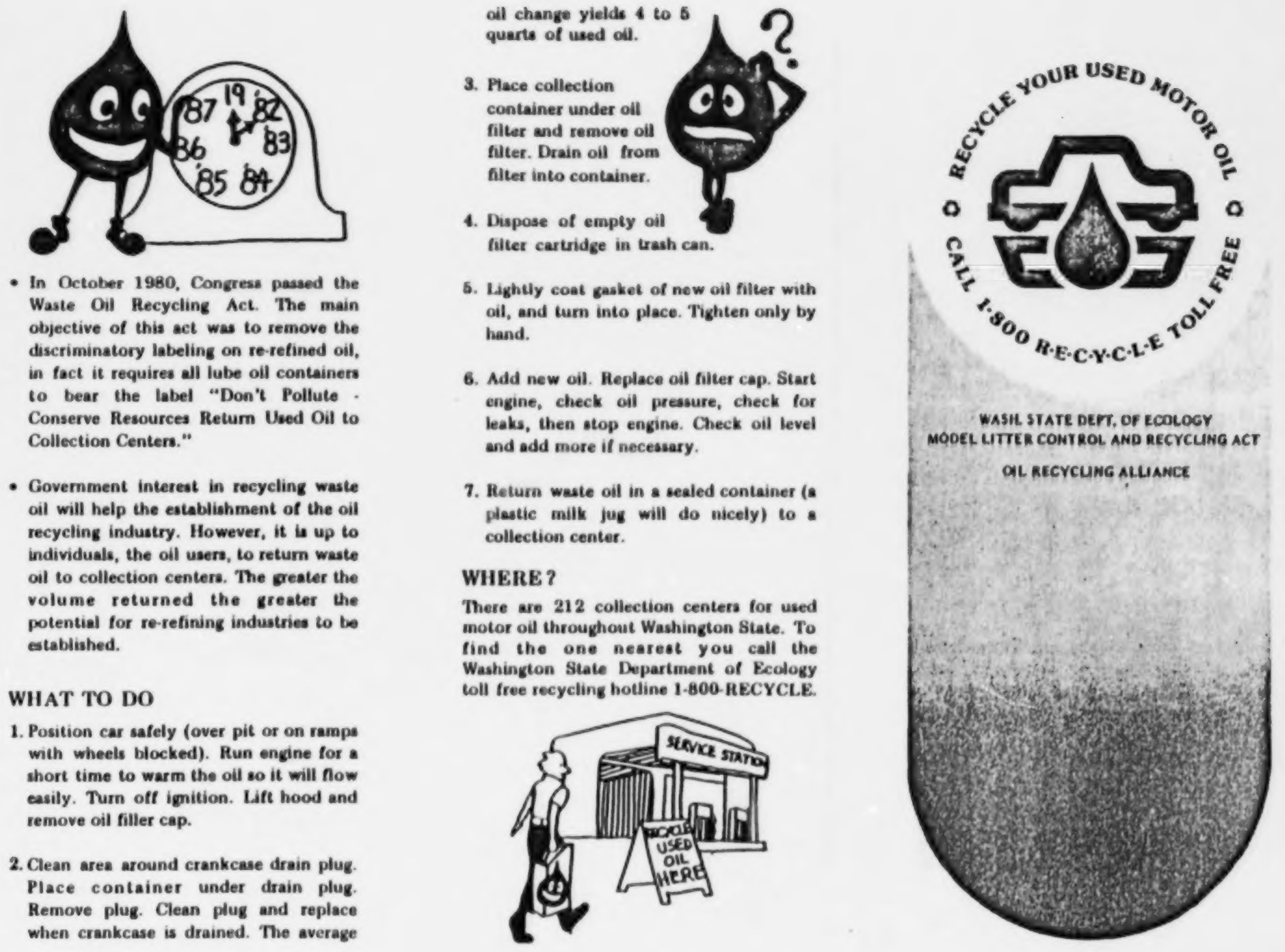
The core of our public education program is the collection of educational activities for use in schools, called SLEUTH, developed as Report D of the HHWD series. We decided to put most of our energies into SLEUTH for two main reasons:

- Long-term effectiveness. We felt that the best way to accomplish the change in public attitudes that we sought was to work with school children. This is the "seed" strategy -- by planting these ideas now, we hope to increase the number of citizens who carry this thought process into their disposal decisions in the future.

Table 31. MEMBERS OF THE OIL RECYCLING ALLIANCE (ORA).

Association of Sewer Districts
City of Bellevue
King County Planning Division
Metro
Northwest Tank Service, Inc.
United Drain Oil Service, Inc.
Washington Citizens for Recycling
Washington Department of Ecology

Figure 3. OIL RECYCLING BROCHURE (reduced)


19
82
83
84
85
86
87
?
SERVICE STATION
RECYCLE USED OIL HERE

- In October 1980, Congress passed the Waste Oil Recycling Act. The main objective of this act was to remove the discriminatory labeling on re-refined oil, in fact it requires all lube oil containers to bear the label "Don't Pollute - Conserve Resources Return Used Oil to Collection Centers."

- Government interest in recycling waste oil will help the establishment of the oil recycling industry. However, it is up to individuals, the oil users, to return waste oil to collection centers. The greater the volume returned the greater the potential for re-refining industries to be established.

WHAT TO DO

1. Position car safely (over pit or on ramps with wheels blocked). Run engine for a short time to warm the oil so it will flow easily. Turn off ignition. Lift hood and remove oil filler cap.

2. Clean area around crankcase drain plug. Place container under drain plug. Remove plug. Clean plug and replace when crankcase is drained. The average oil change yields 4 to 5 quarts of used oil.

3. Place collection container under oil filter and remove oil filter. Drain oil from filter into container.

4. Dispose of empty oil filter cartridge in trash can.

5. Lightly coat gasket of new oil filter with oil, and turn into place. Tighten only by hand.

6. Add new oil. Replace oil filter cap. Start engine, check oil pressure, check for leaks, then stop engine. Check oil level and add more if necessary.

7. Return waste oil in a sealed container (a plastic milk jug will do nicely) to a collection center.

WHERE?

There are 212 collection centers for used motor oil throughout Washington State. To find the one nearest you call the Washington State Department of Ecology toll free recycling hotline 1-800-RECYCLE.

RECYCLE YOUR USED MOTOR OIL ○ CALL 1-800 R·E·C·Y·C·L·E TOLL FREE ○

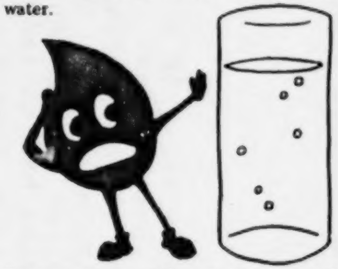
WASH. STATE DEPT. OF ECOLOGY
MODEL LITTER CONTROL AND RECYCLING ACT

OIL RECYCLING ALLIANCE

Figure 3. OIL RECYCLING BROCHURE, continued (reduced)

OIL AND WATER DON'T MIX !

Used motor oil contains many contaminants and if disposed of improperly can be a threat to the quality of our environment. Oil dumped in storm sewers or on the ground can eventually wind up in water supply systems, streams, rivers and lakes. When oil is disposed of in landfills, surface water can wash oil from the disposal site into the groundwater and then carry it into nearby streams and rivers. Oil used to control dust on roadways or oil dripping from leaking cars and trucks can also pose a problem in that the run off can eventually reach and contaminate otherwise clean water.



Concentrations of 1 part oil to a million parts water can cause taste and odor problems in drinking water. At that ratio it would only take one quart of oil to seriously contaminate 250,000 gallons of water, that's more water than 30 people will drink in a lifetime.

IT'S WORTH IT !

Because of the rising cost of oil and service fees more and more people are servicing their own automobiles at home. Changing oil is one of the most frequent and routine service requirements and many people are trying to cut costs by changing oil themselves. A universal problem for these do-it-yourselfers is what to do with the used oil. The only proper method of disposal is to return it to a service station, recycling center, or collection depot so that it can be re-refined into motor lubricant again or used as fuel in boilers to generate steam.

The real future for used oil lies in re-refining for many reasons. Every 42 gallons of high quality crude oil that goes into a refinery to be "cracked" into various petroleum products yields only 2½ qts. of motor oil. On the other hand it only takes 1 gallon of waste oil to produce the same amount. With minimal treatment it can be used to supplement fuel supplies for industrial operations.

Some waste oil is not re-refined into usable motor oil, but it is not wasted. As more and more people conserve by returning used motor oil it will become increasingly feasibile for re-refinery operations to be built.

Re-refined or burned as fuel, used oil is a valuable resource.

YOU CAN'T WEAR IT OUT !

More than 4.5 million gallons of waste oil are discarded every year in Washington State. However, waste oil is a valuable resource and throwing it away is seriously affecting our environment.

Oil can be re-refined over and over because it never loses its lubricating properties. As it circulates throughout the engine block and crankcase it picks up metals and acids that come from friction between the metal parts of the engine and the combustion process. These contaminates can be removed through the re-refining process to the extent that it becomes as good as new for lubricating purposes.

THE TIME IS RIGHT !

There are several reasons for recycling used oil.

- High quality crude oil for the production of lubricants is becoming less available. The preferred crude oil is low in sulphur content. This type may yield as much as 20 percent lube oil while other high sulphur crudes will yield fractions of a percent, as a result, less than 2 percent of the crude processed in the United States becomes lube oil.

- Short-term economy. Because of limited funding and staff time, we chose to develop a school packet which, once handed out, will continue "working" with minimal maintenance effort. Slide/talk shows and even brochures require continual staff time to distribute or man.

In addition to this long-term, attitude-changing type of public education, however, we do have some immediate information to communicate to the public, e.g., what household toxicants to be cautious of, phone numbers to call, how to recycle, etc. We plan to accomplish this kind of information transfer through the following media:

- Public service announcements on TV and radio;
- Newspaper articles about the project;
- An update of the "Toxic Substances in Your Home" brochure;
- "Dial Extension" tapes, through the Washington State Cooperative Extension, on household hazardous waste and what to do about it; and
- A speaker's bureau, drawing on members of the HHWD Committee and Metro staff to speak to interested groups.

(f) HHWD Committee. The continued existence of the HHWD Committee -- and the network which it represents -- will provide the "glue" to hold the regional control plan together. We will switch from being an active working committee meeting every two weeks, to a more advisory capacity, meeting approximately every two months. Through this on-going process, we can oversee continuing projects (e.g., the Dump Day, ORA, educational efforts), focus on specific recommendations for future action, resolve problems in the use of the Directory or collection systems as they arise, and generally act as a resource, network and clearinghouse. The "Recommendations for Future Action" in section IV B (to follow) will serve as an initial agenda for post-project follow-up.

C. OTHER SOLUTIONS

The HHWD Project has not been working in a total vacuum in the development of the regional control plan. One of our first tasks was to contact other agencies and organizations around the country already engaged along similar lines. We did not want to reinvent the wheel nor spend a lot of time and energy developing recommendations if someone else had already done so. We found that quite the opposite was true, however; most of the people we contacted were looking to us to develop a program that they could then adapt. In many cases this has already started.

It is interesting to compare the similarities and differences between the approaches being developed around the country. The number of agencies or organizations presently active or interested in the household hazardous waste issue are too numerous to explore in-depth here. Instead, we provide a brief description of some efforts that we are aware of, along with a contact name (if available) and address for further information.

These efforts fall into several general categories:

1. Programs That Have Developed Disposal Recommendations

There are only a few programs which have actually come up with detailed suggestions for consumers.

- The Oregon Department of Environmental Quality (DEQ) has produced a fact sheet (see Table 32) on how the citizens of Oregon should dispose of their common household chemicals. Because they are intended to be used on a statewide basis, the recommendations are of necessity very general and use existing disposal means such as household refuse, landfill and hazardous waste collection sites (not accessible in some areas).

  Contact: DEQ - Solid Waste Division, P.O. Box 1760, Portland, OR 97207

- The Tacoma-Pierce County Health Department in Washington State has put together a booklet entitled "Hazardous Waste in My Home?" (Lowry, 1981), which contains directions for household hazardous waste disposal. These directions tend to emphasize using the product up or giving it away as the first procedure, and then provide a range of other options that the citizen may choose from, including use of non-toxic alternative products where appropriate.

  Contact: Tacoma-Pierce County Health Department, 3629 South "D" Street, Tacoma, WA 98408

- The Metropolitan Area Planning Council (MAPC) in Massachusetts is in the process of developing a handbook called "The Safe Use, Storage, and Disposal of Household Chemicals." As the name implies, the handbook covers other topics besides disposal, but it does contain specific disposal suggestions for the citizen (see Table 33). It suggests some other recommended practices as well, such as:

  -- purchase and use of smallest quantity necessary; and
  -- review of labels for manufacturers' disposal instructions or contact of the manufacturer or retail supplier if instructions are lacking.

TABLE 32. OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY'S "RECOMMENDED DISPOSAL METHODS FOR COMMON HOUSEHOLD CHEMICALS*"

Product/Chemical	Disposal Recommendation
PESTICIDE PRODUCTS: Rat Poison, insectcide, weed killer	A, B, C
EMPTY PESTICIDE CONTAINERS:	B, C
FLAMMABLES: Alcohol, acetone, turpentine, lacquer, paint thinner, other petroleum distillates such as gasoline and kerosene	A, B, C
CAUSTICS: Oven cleaner, drain cleaner, bleach	B, C
STRONG ACIDS (pH lower than 5.5): Battery Acid, muriatic acid	A, B, C
WEAK ACIDS (pH higher than 5.5): Acetic acid, toilet bowl cleaner, vinegar, lactic acid	B, C, D
OUT-DATED MEDICINES:	D
PAINT, PAINT REMOVER:	B, C
WASTE MOTOR OIL:	E

Disposal Methods

A. Take to a Hazardous Waste Collection Site. Call the Department of Environmental Quality Solid Waste DIvision to find out if there is a site in your area--229-5913 in Portland or toll free 1-800-452-7813 for other areas of the state.

B. Wrap securely in plastic bag and dispose with other household refuse. Notify your collector.

C. Take to an authorized solid waste landfill. Notify the landfill operator.

D. Wash down drain with large quanities of water or flush down toilet. It is illegal to put flammables or strong acids or caustics into the sewer.

E. Deposit at local oil recycling depot. For the location of the depot nearest you call 224-5555 in Portland or toll free 1-800-452-7813 for other areas of the state, ask for the Recycling Information.

*For small quantities only.

Table 33. MASSACHUSETTS METROPOLITAN AREA PLANNING COUNCIL'S "CURRENT METHODS TO DISPOSE OF HAZARDOUS HOUSEHOLD PRODUCTS."

PRODUCT	Take to a haz. waste collection site (or store until available)	Wrap in plastic bag, put in trash, and alert the collector	Wash down drain with lots of water	Take to special recycling center (not paper recycling)	Give to friend to use with careful instructions	Return to manufacturer or to the retailer
ACIDS (STRONG)	Best	Never	Never	Unavailable	Impractical	Impractical
ACIDS (WEAK)	Best	4th Best	3rd Best	Unavailable	2nd Best	Impractical
BANNED PESTICIDES	2nd Best	Never	Never	Never	Never	Best
BATTERIES	3rd Best	Never	Impractical	Best	Never	2nd Best
CAUSTICS	Best	3rd Best	4th Best	Unavailable	2nd Best	Impractical
EMPTY PESTICIDE CONTAINERS*	Best	2nd Best	Impractical	Unavailable	Impractical	Impractical
FLAMMABLES	Best	3rd Best	Never	Unavailable	2nd Best	Impractical
OUTDATED MEDICINES	Best	3rd Best	2nd Best	Never	Never	Impractical
PAINT	2nd Best	3rd Best	Never	Unavailable	Best	Impractical
PAINT REMOVER	Best	Never	Never	Unavailable	2nd Best	Impractical
PESTICIDES	Best	3rd Best	Never	Unavailable	2nd Best	Impractical
USED MOTOR OIL	3rd Best	Never	Never	Best	Never	2nd Best
WOOD PRESERVATIVES ("Penta")	Best	2nd Best	Never	3rd Best	Impractical	

* Pesticide containers should be triple-rinsed, and the contents sprayed on crops or yard, before discarding.

Note: Strong acids include battery acid, muriatic acid, and hydrochloric acid. Weak acids include acetic acid, toilet-bowl cleaner, and lactic acid. Banned pesticides include Silvex, Mirex, Aldrin, Chlordane, DDT, and Heptachlor. Caustics include oven cleaner and drain cleaner. Flammables include alcohol, acetone, turpentine, lacquer, and paint thinner. Pesticides include rodent poisons, insecticides, weed killer, and other herbicides and fungicides.

Source: Galvin, D.V. and S.M. Ridgley, Household Hazardous Waste Disposal Project: Technical Memorandum, Toxicant Control Section, Water Quality Planning, Municipality of Metropolitan Seattle, for the US Environmental Protection Agency, under Grant #P-000233-01, November 1981.

This table has been reviewed by staff from the Division of Hazardous Waste in the Massachusetts Department of Environmental Quality Engineering, and by staff from the Bureau of Solid Waste Disposal in the Massachusetts Department of Environmental Management.

In addition to the general recommendations shown in Table 33, the MAPC has also developed more detailed directions on the disposal of photographic chemicals, pesticides, waste oil, car batteries, banned products, art supplies, paints, solvents, and ammunition and other explosives.

Contact: Karen Pierson, MAPC, 110 Tremont Street, Boston,
MA 02108 (617) 451-2270

- The U.S. EPA has developed three references which address portions of the disposal issue. Guidelines for the Disposal of Small Quantities of Unused Pesticides (Lawless et al., 1975) deals exclusively with pesticides. The report was developed for professional disposal firms and manufacturers, and is much more technical than the householder needs or is able to use. A second EPA report likewise is concerned with pesticides -- in this case, Disposal of Dilute Pesticide Solutions (Day, 1976). It examines the current disposal practices and studies on pesticide "rinsate" from commercial or industrial processes and cleanup operations. Unfortunately, most options are not adaptable to the householder's situation.

  A third EPA report is much more applicable to the situation that the consumer is faced with. Disposing of Small Batches of Hazardous Wastes (Ghassemi et al., 1976) is a guide to "assist the holders of small batches of waste in determining if a waste contains hazardous components and, if so, how it should be handled in order to protect the public health and the environment." This is not limited to household items, but also includes chemical wastes from small businesses and manufacturers and from commercial, university, and high school laboratories. The reader is directed towards certain sources to determine the character of his waste; these include the manufacturer or distributor, reference manuals, labels on products, and local, state, and federal agencies.

  Ghassemi et al. (1976) then provide several recommendations for the disposal of the waste once it has been identified. They caution that choosing the most desirable option is dependent on the nature of the waste, where it was generated, and the applicable local ordinances and state regulations. Provided these are known, the small batches of hazardous waste could then be disposed of by (in order of preference):

  - recycling or returning to supplier;
  - disposal in hazardous waste management facilities (in the Seattle area, that means a private waste disposal firm such as ChemPro);
  - "in-house" treatment/disposal (this would entail rendering the waste harmless and less hazardous, e.g., detoxified, neutralized or encapsulated in cement);

- -- hazardous waste disposal in municipal incinerators (requires approval from local agency responsible for solid and hazardous waste disposal);
- -- hazardous waste disposal in sanitary landfill (again, local agencies must be contacted).

2. Programs That Have Developed Collection Systems

A number of programs have been developed that are oriented towards the collection of household chemicals:

- Marion County (Kentucky) Health Department organized what it called a "pesticide recall" in January, 1981, which was a well-publicized, week-long collection program, similar to the "Dump Day" that Metro plans to organize as part of the Seattle control plan. Funded by the county fiscal court and drawing on available resources, the Health Department collected 1,400 pounds of solid materials and 450 to 500 gallons of liquid chemicals -- a total of 17 barrels of hazardous waste -- in one week (Brock, 1981). A neighboring county (Garrard) organized a similar recall program and collected six barrels. These high volumes were probably due to the mostly rural (30 to 35%), heavily agricultural character of these counties, and to the fact that farmers and retail stores were allowed to use the service.

- A similar "Dump Day"-like collection program is in the planning stages at the time of this writing in Lexington, Massachusetts. A cooperative effort between the Lexington Fire Department and the League of Women Voters, the one-time-only collection of pesticides is scheduled for some time in the fall of 1982.

  Contact: John Bergeron, Chief, Lexington Fire Department,
  45 Bedford Street, Lexington, MA 02173 (617) 862-0272

- Another type of approach could be called the "one-man-show." This collection program consists of one local person who knows a lot about the products and about local disposal resources, and informally matches the two together. The Louisville/Jefferson County (Kentucky) Health Department typifies this approach. It handles calls on a case-by-case basis, using the following general procedures:

  - -- solvents: take to reprocessor or mix with absorbent and put in trash;
  - -- acids/bases: neutralize at lab;
  - -- motor oil: recycle, via bulk retailers (state law);
  - -- appropriate chemicals: add on to waste stream of school or university; and
  - -- paints: return to manufacturer, or evaporate liquids and put in trash.

Contact: Clark Bledsoe, Department of Public Health, Louisville and Jefferson County, P.O. Box 1704, Louisville, KY 40201 (502) 587-3885

- Multnomah County (Oregon) Fire Department also runs a "one-man-show" collection system. For about six years, a person in the Fire Department has operated a low-key program using his particular knowledge about household hazards. He will transport and dispose of domestic chemicals by citizen request. The disposal procedure depends on the substance involved; the usual protocol is:

  - flammables (solvents, gases): incinerate in the Bomb Squad's burn pit;
  - acids/bases, some pesticides: neutralize; and
  - other chemicals: exchange for useful chemicals with industries or take to county landfill or hazardous waste site.

  Contact: Len Malmquist, Multnomah County Fire District, P.O. Box 16368, Portland, OR (503) 760-1081

- An on-going collection system for household pesticides has been operating in British Columbia for four years, funded by the Waste Management branch of the B.C. Ministry of Environmental Control. A staff technician at each of the eight regional offices is responsible for collection procedures. They will accept waste pesticides from schools, households and small generators in quantities of less than one 55-gallon drum. They then ship these wastes to the hazardous waste landfill run by Chem-Security Systems, Inc., in Arlington, OR. No contacts for this program.

- A demonstration collection program is set currently being run in Sacramento, California. For ten weeks, all household hazardous waste (except radioactive wastes) is being accepted at the City's solid waste transfer stations. The transfer stations, which are privately managed by American Waste Container Services, Inc., receive, inventory and package the wastes. This pilot project is being jointly funded and managed by a number of agencies, including Sacramento County Health Department, Golden Empire Health Systems Agency, other County departments, and the State of California. At the end of the ten weeks, the project will be evaluated and a decision made on a long-term program. Interim reports indicate that this program has been highly sucessful.

  Contact: Gina Purim, Golden Empire HSA, 827 - 7th Street, Suite 431, Sacramento, CA 95814 (916) 447-3201

- Finally, there are a number of communities which are planning to set up collection systems, such as:

- Department of Ecology - Yakima (WA) hopes to operate a pesticide collection (Dump Day?) program in the spring of 1983.

  Contact: Clar Pratt (509) 575-2490

- Whatcom County (WA) Health Department plans to set up an on-going pesticide collection program, by appointment only, similar to the one currently in effect in Seattle/King County. We understand that this will involve use of transfer stations as collection points, with transportation and disposal fees donated by local industries.

  Contact: Janis Gedlund (206) 676-6724

- Snohomish County (WA) Health Department has expressed interest in setting up a similar on-going pesticide collection program.

  Contact: Art Willey (206) 259-0693

3. Plans Which Have Considered Household Hazardous Waste

There are two public planning efforts that we are aware of which considered the influence of residential wastes on environmental quality, but which did not actually develop collection programs.

- The Oregon DEQ commissioned a study recently by Resource Technology Corporation (1982) to develop a basic design for small quantity collection/storage facilities which could be used by all Oregon cities with populations greater than 10,000 people. This study determined several interesting points concerning small quantities of hazardous waste.
  - over 89% of the small generators of hazardous wastes (less than 1,000 kg/month) are from the non-manufacturing sector;
  - although household wastes are excluded under both EPA and Oregon regulations, "ideally, all the excluded wastes would go to a chemical waste disposal facility.. ..to ensure proper handling to minimize any environmental pollution, especially groundwater pollution, that might occur;" and
  - hazardous waste that was collected from residential sources could either be:
    - disposed of at a licensed hazardous waste disposal or treatment facility, or
    - "recycled" by having a trained collection/storage facility operator identify local users before classifying the waste as a hazardous waste. The

operator would need to understand "the potential liabilities with dispersing any non-verified chemical materials."

- The Genoa Township (Michigan) Advisory Task Force on Groundwater Protection (1982) developed a policy plan to guide future actions to protect local groundwater resources. The task force identified existing or suspected threats to the groundwater, including septic tank system failure and the disposal of polluting materials by homes and farms. Since Genoa Township is dependent on septic tank systems for wastewater treatment, the task force highlighted such issues as improper siting practices and improper septic system use and maintenance.

  The improper disposal of toxic and hazardous chemicals from farms or homes was identified as a possible threat to groundwater. The study indicated that, if permitted by the landfill operator, small quantities of toxic materials can be disposed of in the landfill. It also noted that the Livingston County Health Department and County Cooperative Extension Service have information on proper disposal methods and it proposed that additional public education materials be developed on this topic.

4. Programs Which Have Produced Educational Materials

All the collection programs mentioned previously have developed some sort of educational materials to "get the word out." These have ranged from radio and television advertisements to press releases to one-page flyers to large booklets. However, some communities have put their main emphasis on educational materials rather than on collection programs, product restrictions, or other control techniques.

- The California Public Interest Research Group (CalPIRG) in San Diego has produced several brief newsletters on household cleaners and alternatives to pesticides.

  Contact: CalPIRG, 300 "E" Street, San Diego, CA 92102
  (714) 236-1508

- The Cumberland County (New Jersey) Department of Health has produced a slide-tape program, patterned after the Tacoma-Pierce County Health Department's brochure "Hazardous Waste in My Home?" (Lowry, 1981).

  Contact: Donna Davis (609) 451-8000, extension 371

- The Toxic Substances Education Group, which is affiliated with Huxley College of Environmental Studies, Western Washington University (Bellingham, WA) has produced a small textbook for middle or junior high school students, called Toxic Substances in the Environment (Toxic Substances Education Group, 1982). The book includes a chapter on "Chemical Hazards in the Home." Contact Ron Kendall (206) 428-1558.

It is highly likely that there are other groups and communities which are actively working on the issue of household toxicants and hazardous waste disposal, but which we did not become aware of during this project. To the extent that Metro can continue to serve as a networking center on this issue, information on other programs would be welcome.

SECTION IV

CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Origins and Objectives

This EPA-funded project was designed to develop a program which would ultimately "reduce the quantity of toxic substances entering the areawide waters from residential activities" (Metro, 1981).

Objectives of the project were:

- To outline the pollution problem associated with improper disposal of household hazardous wastes;
- To determine which options exist for proper disposal;
- To evaluate effectiveness in this local region (the Seattle area) of one or more disposal options in a pilot study;
- To establish a coordinated policy among the agencies and businesses involved in household product sales, use, regulation and disposal for the proper disposal of the various types of toxicant-containing wastes; and
- To develop and explore ways to implement a disposal plan for the region.

The Household Hazardous Waste Disposal (HHWD) Committee was the major project planning and decision-making body. The Committee was composed of representatives of government agencies, private businesses, service organizations, public interest groups, and private citizens.

2. Legal Framework

Federal regulations which control the content and labeling of consumer products, including bans and restrictions, are:

- Federal Hazardous Substances Act, which establishes labeling requirements and sets up banning procedures;
- Consumer Product Safety Act, which establishes the Consumer Product Safety Commission and regulates the development of product safety standards, labeling requirements and product bans;

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- Federal Food, Drug and Cosmetic Act, which directs the Food and Drug Administration to ensure that foods are safe to eat, that drugs are safe and effective, and that packaging and labeling is truthful and informative;
- Federal Insecticide, Fungicide and Rodenticide Act, which regulates the manufacture, registration, labeling, use, disposal, and cancellation of pesticides;
- Toxic Substances Control Act, which requires premarket evaluation of all new chemicals (other than food additives, drugs, pesticides, alcohol and tobacco), and testing/reevaluation of existing chemicals, and which regulates the manufacture, processing, distribution, use and disposal of "hazardous" chemicals.

Federal regulations which deal with the disposal of toxic substances are:

- Resource Conservation and Recovery Act, which establishes a regulatory program for management of hazardous wastes, including identification and standards for generation, transport, storage and disposal;
- Clean Water Act, which controls pollution discharges into water, including development of water quality criteria for certain priority toxic pollutants and regulation of direct or indirect spills;
- FIFRA, which establishes procedures for storage and disposal of excess pesticides.

There are a number of Washington State regulations which concern toxic substances in products, but most do so only marginally and are not as inclusive as the federal regulations. Exceptions to this general statement include state regulations for poisons (Washington Caustic Poison Act) and pesticides (Washington Pesticide Control Act, Washington Pesticide Application Act).

The primary state regulation which deals with hazardous wastes, the Washington Hazardous Waste Disposal Act, is the state equivalent of the federal RCRA and contains some stricter provisions than RCRA. Solid Waste Management and Water Pollution Control Codes also briefly touch on this issue.

Regulations at the local level in the Seattle/King County area address only the disposal of materials, and, in general, do not control hazardous substances to any significant degree.

3. The Problem: Product Contents

In general, obtaining information on the content of products is often difficult or impossible. Information on contents is protected by trade secrets; data on quantities used or disposed of have not been determined or are unavailable; and, for some chemicals, acute and chronic toxicity data and information on environmental effects are wholly lacking.

Household hazardous wastes are not effectively regulated at this time. Labeling of products, whether for contents, use or safe disposal, is often misleading and/or inadequate and in many cases hinders the consumer's ability to make choices. Household quantities of wastes, regardless of their toxicity or hazard, are generally not regulated.

Pesticides:

- Household pesticides come in a wide variety of classes, including chlorinated hydrocarbons, carbamates, organophosphates and natural product extracts.
- The types of pesticides classified for general use have changed in the past ten years; although many persistent chlorinated hydrocarbon pesticides (e.g., DDT) have been banned, there has been a tradeoff in use in that the faster-to-break-down pesticides (e.g., carbamates) often tend to be more acutely toxic.
- An elaborate regulatory system for classification, review, labeling and use of household pesticides has been set up under FIFRA, but no equivalent system or recommendations have been established (under FIFRA, RCRA, TSCA or other laws) for disposal. The existing regulatory system for pesticides, while elaborate, is not useful or intelligible to the average citizen and is, in many ways, misleading.
- Pesticides can enter the environment in a myriad of ways, by direct disposal, runoff, atmospheric processes, and accidental spills. Several factors influence the amount lost through runoff, including the pesticides formulation, the site of application, and the time of application.
- Very little is known about the interaction of pesticides with the environment under actual field conditions, especially the effect of long-term exposure on organisms and the fate of degradation products.
- Conflicting and inadequate test data and a paucity of information on chronic effects make any ranking of pesticides by disposal hazard very difficult. However, it appears that certain classes such as the natural extracts (botanicals,

synergists) have much less potential for environmental damage than some of the more powerful or persistent synthetic products.

Paint products:

- Paints as a class appear to pose relatively little potential for environmental harm through current proper disposal methods for two reasons:
  1. paints usually don't contain chemicals with long-term effects, and
  2. irresponsible use or disposal practices are probably rare.

- Many solvents present human health hazards of an acute or chronic nature, are toxic to aquatic organisms in low concentrations, and may contribute to atmospheric pollution. The persistent chlorinated hydrocarbons are of particular concern in this regard.

- Wood preservatives such as pentachlorophenol, while generally considered to be paint products, are extremely toxic pesticides, and are usually resistant to breakdown under natural conditions.

Household cleaners:

- Cleaners often contain toxic or hazardous substances, but generally present more of an acute human toxicity concern through household use (which is widespread) than an environmental problem in disposal.

- Labeling is generally inadequate for determining specific contents and/or their hazards (poor labeling seems to be more of a problem with cleaners than other product classes).

- Organic solvent constituents seem to be of greatest concern, especially such disinfectants as chlorinated phenolics, and dry cleaning or septic tank/drainfield degreasing solvents such as 1,1,1-trichloroethane. They produce a wide range of serious chronic effects, and are suspected of being a source of groundwater contamination in some parts of the country.

- Other specific household cleaning chemicals which may affect the environment through their disposal are: chlorinated phenolics (little is known about their long-term effects); detergents (used in enormous quantities); and aerosol propellants (human health concerns, possible environmental effects).

Automotive products:

- Significant quantities of motor oil are used and inadequately disposed of locally; about half of all households change their own oil, but only about 18% recycle the used product.

- Petroleum products are primarily hazardous as environmental pollutants, with problems associated with their physical effects (coating surfaces, odor) as well as toxicological effects (both acute lethal and long-term sublethal). Some components of waste petroleum products can accumulate in sediments and bio-accumulate in organisms.

- Most of the motor oil recycled in King County is burned as a fuel, raising an air quality concern; re-refining for re-use as a lubricant would be preferred.

- Gasoline is an extremely dangerous substance commonly found in households; it is seldom disposed of, but when dumped presents acute and chronic toxicity problems as well as acute flammability concerns.

- Ethylene glycol in antifreeze presents an acute toxicity problem in concentrated form (as in a car radiator), but appears to be broken down adequately if diluted in the sewage treatment system or soil.

In general, household products are less toxic/hazardous than those used in commercial or industrial processes; consumer products have tended in recent years to become safer or to contain smaller quantities or fewer kinds of the better-documented toxic chemicals, either in response to regulation, economics (including increased costs of constituents and hazardous waste disposal), the market place or liability concerns.

4. The Problem: Effects in the Environment

An examination of the major pathways of disposal is the best way to approach the question of whether residential-toxic wastes affect the environment.

- Recycling: Used motor oil is currently the only toxic consumer product for which recycling is a feasible option. Although locally used oil is reprocessed only, re-refining is the preferable treatment means. Oil that is not recycled, but instead is either directly or indirectly dumped in the environment, can have both short- and long-term harmful effects.

Given the accessible collection system which currently exists, it appears that the key to increased oil recycling lies in public attitudes.

- Landfilling: Most of the studies on residential solid waste have not examined its hazardous component. A study in Los Angeles determined that most (92%) containers for hazardous consumer products are empty. They concluded that the capacity of the landfills was sufficient to absorb the liquid that was in the remaining containers.

- Septic Tank/Drainfield: Leachate from residential on-site (septic tank/drainfield) wastewater treatment systems is a contributing factor to groundwater pollution. Studies which sampled septic tank septage from residential sources have found elevated levels of complex organic chemicals, such as 1,1,1-trichloroethane, chloroform, dichlorobenzenes, several phthalates, phenols, pyrene, methylene chloride and toluene.

  Given the manner in which many of these synthetic organic molecules behave in a septic tank/drainfield system, concern about groundwater contamination appears to be justified. Some of the organic pollutants showed no removal in the treatment system and essentially moved out into the environment unscathed. Once there, many synthetic organics are immune to degradation and do not absorb to soil particles.

  Cleaning products used for degreasing of septic tanks or cesspools have been demonstrated to pose a clear threat to groundwater resources. Not only do they contain chlorinated hydrocarbons which move easily through the soil, but they are intended to be directly discharged into the soil environment.

- Central Wastewater Treatment: On the average, approximately one quarter of the metals that are discharged to publicly-owned sewage treatment works are from residential sources. These metals in residential discharges originate primarily in tap water, but also from food materials and non-food commodities. Toxic consumer products are usually a minor contributor to the metal loading.

  Relatively few organic compounds are found in residential discharges when compared to industrial sources, and these are at low concentrations. Pollutants that appear regularly in the few analyses performed on residential wastewater include chloroform, benzene, pentachlorophenol, toluene, naphthalene, a wide range of phthalates, phenols, and tetrachloroethylene. It is difficult to make any connection between the presence of these chemicals in residential sewage, and the disposal of consumer products containing these chemicals, though a relationship is suggested.

Concentrations of organic chemicals in residential sewage are generally higher on weekends than on weekdays, and higher in old residential areas than in newer ones.

5. Solutions: Pilot Study and Surveys

Public opinion surveys conducted in Seattle determined that people are aware that some products in their home are toxic or hazardous. Their awareness of which products are more hazardous is based on acute poisoning concerns.

The public expressed a high degree of concern about the HHWD issue. When asked why they were concerned, most people said it was for environmental reasons (as opposed to personal or family health reasons).

A large majority of the public indicated that they don't frequently dispose of toxic/hazardous products. This finding was supported in the pilot collection program, in which only about one percent of the test population participated. This leads to the conclusion that a massive collection system for household hazardous wastes is probably not warranted.

While an extensive collection system is not needed, the level of interest and widespread presence of toxic substances indicate that some control program would be worthwhile. Banned pesticides exist in substantial amounts in homes and would warrant a "sweep out" such as a regional dump day in conjunction with an on-going but less convenient collection service such as the five Health Department sites.

Used motor oil presents a different case. About half of the people changed their own oil, and thus had waste oil to dispose of. Since convenient collection sites (i.e., gas stations) are available, promotion of oil recycling awareness is warranted.

Given the level of interest and expressed willingness to change habits if provided with information, increased public education on the HHWD issue would be worthwhile and well accepted.

6. Solutions: Regional Control Plan

The plan developed for the Seattle/King County area for the control of household hazardous wastes is based upon the Product Disposal Recommendations. These guidelines, developed and endorsed by all agencies and organizations in the metropolitan area, provide consistent answers for all public inquiries concerning disposal of toxic wastes. The support programs necessary to back up the Recommendations and get the word out to the public form the other components of this plan.

The Regional Control Plan consists of six items:

- Product disposal recommendations;
- Health Department/ChemPro collection sites: an on-going program to collect unwanted or banned pesticides at four Health Department offices, plus other wastes in addition to pesticides at ChemPro;
- Dump Day collection program: an annual sweep-out for pesticides, to be held on a spring or fall weekend;
- Oil recycling promotion: support of the Oil Recycling Alliance and related activities;
- Public education: distribution of educational activities information (SLEUTH), brochures and other public outreach avenues;
- HHWD Committee: continued meetings of the committee to oversee plan implementation, continue work on recommendations (see below), act as a network and clearinghouse and resolve problems as they arise.

B. RECOMMENDATIONS FOR FUTURE ACTIONS

The regional control plan, as described more fully in Section III, constitutes the primary result of the HHWD project. There were a number of areas of concern which we were not able to deal with in the Plan. The HHWD Committee therefore developed the following recommendations as additional courses of action that we have concluded are necessary to safely and effectively manage toxic waste from residential areas. This list will form a partial agenda for continued actions of the HHWD Committee.

1. Labeling

Product labeling procedures affect the safe use and disposal of household hazardous wastes, yet local actions to affect labels are virtually impossible. On a national level, we recommend that:

- Information on product constituents and both their health and environmental effects (where known) should be more readily available to the consumer who wishes access to such information. This may not necessarily be on the label, since complex chemical names are seldom helpful to the average consumer.

- Product labels should always include information on how to dispose of (or recycle) waste or excess products and empty containers.

- Some system should be developed to provide a simplified indicator of preferred disposal method and to include this general information (in the form of symbols or signal words) on all labels.

2. Product Restrictions

It appears that bans or restrictions on certain products are not warranted locally based on information available to this project.

3. Alternatives (Use)

While not addressed directly in this project, alternatives to many toxic/hazardous products exist. Information on benign alternatives should be developed and made available to the public as a way to reduce hazardous waste at the source.

4. Alternatives (Disposal)

Retailers and manufacturers of toxic consumer products should cooperate in the development of a system to accept excess or unwanted products at the place of purchase for either disposal or recycling.

To encourage oil recycling, governmental incentives should be set up to encourage the development of an oil re-refinery in Washington State.

5. Environmental Effects

Recommendations for future actions that will lessen the effects that consumer products have on the environment are categorized according to affected resources.

a. Groundwater Protection.

- Consumer education on groundwater protection should be encouraged. Special attention should be paid to areas which are served by on-site sewage treatment systems (e.g., septic tanks/drainfields); in particular, in those areas in which drinking water comes from wells.

- King County and the Washington State Department of Social and Health Services, in cooperation with the Department of Ecology, should be encouraged to set more stringent monitor ing and control regulations than the state regulations now in effect for such critical septic tank and well-field areas.

- Other parts of the country have experienced groundwater contamination problems from the use of septic tank/drainfield degreasing solvents, such as 1,1,1-trichloroethane. Based on this experience, use of such products should be discouraged in King County.

b. Landfill Leachate.

- Consumers should be educated (possibly through utility bills?) about what to throw and what not to throw into the trash.

- King County should, if warranted by continued leachate monitoring, tighten surveillance of wastes entering the landfill.

c. Central Sewage Treatment. Toxicant study data show few measurable inputs from residential areas because of dilution; however, the potential is there for contamination from households. Users on the central system should be educated about what to dump and not dump down the drain.

d. Local Streams. Most storm drains in King County connect to the nearest creek or stream. People should be educated about this connection, and cautioned against pouring or flushing oil, antifreeze, pesticides or other items down the street catch basins/storm sewers.

6. Small Quantity and Household Exemptions from RCRA and Washington Hazardous Waste Disposal Act

Both the federal and state regulations identify "really nasty" and "not so nasty" hazardous wastes. For the really nasty ones, both regulations apply for any quantities over 2.2 pounds. For the less nasty, federal regulations exempt any quantities under 2,200 pounds, while state regulations drop the exemption down to 400 pounds; both regulations categorically exempt household wastes.

- A study should be conducted locally to see what types and amounts of hazardous wastes are slipping through these small quantity exemptions, especially from commercial establishments that were beyond the scope of the HHWD project.

- Although difficult to enforce, the household exemption should be eliminated to lend the weight of law to the proper disposal of such "household" quantities as an old three-pound bag of DDT.

7. Siting of a Dangerous Waste Landfill in King County

State law encourages the siting of dangerous waste landfills at the county or local region level.

- Information from the HHWD project lends concern to this issue but does not support development of a King County site because a) the existing private sector disposal system seems to be adequate at this time, and b) the climate is not conducive to such landfill siting.

- For the longer-term view, the City of Seattle and King County, in cooperation with DOE, should investigate alternatives to landfilling for hazardous wastes, e.g., stabilization through treatment, high-temperature incineration or other methods.

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APPENDIX A

HAZARDOUS WASTES AND TOXIC SUBSTANCES

A. HAZARDOUS WASTE

1. What is Hazardous Waste?

RCRA (Resource Conservation and Recovery Act) -- see below -- defines hazardous waste as "solid waste that may cause or significantly contribute to serious illness or death, or that poses a substantial threat to human health or the environment when improperly managed" (Oregon Department of Environmental Quality, 1981). It may come from many sources in our technological society, including hospitals, laboratories, and all levels of government, although industry is by far the largest source. Out of this, the chemicals and allied products industry generates 60 percent of industrial waste (U.S. EPA, 1980b). Hazardous waste generation also tends to be concentrated geographically: 60 percent is generated in 10 states (New Jersey, Illinois, Ohio, California, Pennsylvania, Texas, New York, Michigan, Tennessee and Indiana) (U.S. EPA, 1980b).

A substance is considered a hazardous waste if it falls under one of two situations:

- If it is found on the list of hazardous wastes that EPA has compiled, or
- If it is tested and found to possess any one of the following four characteristics (taken extensively from U.S. EPA, 1980b):
  - Ignitability -- poses a fire hazard during routine management;
  - Corrosivity -- requires special containers because of ability to corrode standard materials, or requires segregation from other wastes because of ability to dissolve toxic contaminants;
  - Reactivity (explosiveness) -- tends to react vigorously with air or water, to explode or generate toxic gasses, and in general to be unstable during routine management;
  - Toxicity -- releases toxicants in sufficient quantities to pose a substantial hazard to human health or the environment.

Some wastes have more than one of these characteristics -- for instance, gasoline is both ignitable and toxic.

Thus, all discarded toxic substances are hazardous wastes, but not all hazardous wastes are toxic substances.

2. How are Hazardous Wastes Controlled?

In 1976, Congress enacted Subtitle C of Resource Conservation and Recovery Act (RCRA) to impose strict controls over the management of hazardous wastes. A complete examination of RCRA and other hazardous waste regulations can be found in Section II B of this report. Briefly, however, RCRA established a national program with three phases to protect human health and the environment.

The first phase consists of a regulatory program, whose central focus is a "cradle to grave" control system to track all significant quantities of hazardous wastes. This regulatory program also establishes how hazardous wastes are identified, the standards which generators and transporters must follow, operating requirements for treatment facilities, a permit system, and guidelines for state programs.

The second phase of RCRA consists of investigations to identify dangerous abandoned dump sites and to force the owners to clean them up. If the owners cannot be found, then the third phase is put into effect. This is actually a separate piece of legislation, the Comprehensive Environmental Response, Compensation, and Liability Act, also known as "Superfund." It provides money to clean up abandoned dump sites, as well as spills of oil and hazardous substances.

Hazardous waste need not be a disposal problem. There are other management options for controlling hazardous wastes; some alternatives are:

- reduction of the amount of waste generated by changing the manufacturing process (using substitutes, keeping wastes separate, etc.);
- reuse of the waste by transferring it to another industry;
- recycling of the waste by removing contaminants and reusing it;
- incineration or treatment of the waste by physical or biological processes;
- disposal at a secure landfill.

3. What is Household Hazardous Waste?

In relation to what we now know about hazardous waste, what is household hazardous waste? According to RCRA, the term "hazardous waste" does not apply to household quantities of any substance, even if it is dangerous or highly toxic. The difference between what is normally called "hazardous waste" and what we are calling "household hazardous waste" relates not so much to the level of toxicity or degree of hazard, but to the quantities of waste involved. Household hazardous wastes are smaller amounts of hazardous wastes. For instance, in Washington State, only hazardous wastes in excess of 400 pounds per month (or batch) are regulated -- household wastes fall well below that exclusion limit. Furthermore, the law specifically exempts household wastes regardless of hazardous potential.

In addition to their definition by quantity, household hazardous wastes can sometimes be differentiated from industrial/commercial hazardous waste by content. Although households will often use the same chemical that is used in an industrial or commercial process, manufacturers will sometimes produce special formulations for use in the home. This may be done for a number of reasons, including safety, legal restrictions, dispensibility or in response to unique conditions in the home. Pesticide formulations for household use are often different than those for commercial use, for instance, or cleaning solutions may be diluted or may use less toxic ingredients.

As mentioned above, a toxic waste is one kind of hazardous waste. Many of the products found in households are of concern primarily because of their toxicity (though they might also be corrosive, flammable, etc.). The following analysis of toxicity and toxic substances is intended to help in understanding the nature of household hazardous waste.

B. TOXIC SUBSTANCES

1. What is a Toxic Substance?

A chemical and a substance are the same thing. Toxic means poisonous. In the broadest sense, then, a toxic substance is a chemical which is able to produce an adverse biological effect or in some way damage -- poison -- a living organism. This definition is not very helpful, however, because every chemical can be toxic if too much of it is present, i.e., if the concentration is too high for the particular circumstances. Water is toxic to a person submerged in it. Obviously many foods, such as oranges, are virtually non-toxic. Other substances are so poisonous that a single taste can be deadly -- *Botulinus* toxin is one example. In this light we can say that there are no harmless substances, only harmless ways of using substances. The reverse of this is also true: There are no toxic substances, only harmful ways of using substances. If the *Botulinus* toxin never gets out of the can, for instance, it is harmless. Through TSCA (Toxic Substances Control Act), Congress has loosely defined a toxic substance as a chemical or mixture of chemicals whose manufacture, processing, distribution, use or disposal may present an unreasonable risk of injury to health or the environment (Segel et al., 1980). Risk is measured in two ways: 1) by the inherent toxicity of the chemical (e.g., oranges versus Botulinus), and 2) by the amount of exposure. The first factor is measured by toxicological testing (usually on animals) -- more on that later. The amount of exposure is determined by finding out how much is entering the environment, what happens once it gets there, and the hazards that it poses throughout its life (including products of degradation).

Thse two factors are taken together to determine the severity of the risk. Decision-makers estimate the potential benefit to society, balance the risk against the benefit, and thereby determine whether there exists an "unreasonable risk" of injury. This entire process is obviously very complicated, and the final assessment must always come down to a value judgement.

2. Toxic Exposure and Dose

Acute means sudden or immediate. Chronic means long-term. These two words are used in two ways when talking about toxicity. We can speak of acute or chronic exposure and acute or chronic effects. Acute exposure is a single or very brief exposure; a one-time event. Chronic exposure is repeated exposure over a long period of time, and in light of that, it is important that the doses and exposures of the chemical substance in question be well-understood. Six abbreviations are used to describe the administered doses. These terms indicate whether the dose caused death (Lethal Dose - LD) or other toxic effect (TD) and whether it was administered as a lethal concentration (LC) or toxic concentration (TC) in the air or water. In general, the term "Lo" refers to the lowest dosage which shows any effect on an organism. Table 34 describes the different types of experimental exposure.

How an organism is exposed to a toxic substance determines whether there will be an effect or not. A toxic substance can be absorbed by living organisms through skin contact, eating and drinking (oral ingestion) or breathing (inhalation). It can cause problems directly by damaging the surface of the body (a local effect) or it can pass through the skin or be absorbed in the body and cause systemic effects of an acute or chronic nature.

Although many exposures to substances in the home or at work occur via inhalation or skin absorption, most studies report exposures in which the substances were introduced through the mouth. Table 35 shows some of the other common routes of exposure, some of them applicable in experimental situations only.

Table 34. DEFINITION OF EXPOSURE TERMS.
(Lewis and Tatken, 1979.)

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1. TDLo: Toxic Dose Low -- the lowest dose of a substance introduced by any route (other than inhalation) over any given period of time and reported to produce any toxic effect in humans or to produce carcinogenic, neoplastic, teratogenic, or mutagenic effects in humans or animals.

2. TCLo: Toxic Concentration Low -- the lowest concentration of a substance in air or water to which humans or animals have been exposed for any given period of time that has produced any toxic effect in humans or produced a carcinogenic, neoplastic, teratogenic, or mutagenic toxic effect in animals or humans.

3. LDLo: Lethal Dose Low -- the lowest dose of a substance introduced by any route (other than inhalation) over any given period of time in one or more divided portions and reported to have caused death in humans or animals.

4. LD50: Lethal Dose Fifty -- a calculated dose of a substance which is expected to cause the death of 50 percent of an entire defined experimental animal populations. It is determined from the exposure to the substance by any route other than inhalation of a significant number from that population. Other lethal dose percentages, such as LD1, LD10, LD30, and LD99, may be published in the scientific literature for the specific purposes of the author.

5. LCLo: Lethal Concentration Low -- the lowest concentration of a substance in air or water which has been reported to have caused death in humans or animals. The reported concentrations may be entered for periods of exposure which are less than 24 hours (acute) or greater than 24 hours (subacute and chronic).

6. LC50: Lethal Concentration Fifty -- a calculated concentration of a substance in air or water, exposure to which for a specified length of time is expected to cause the death of 50 percent of an entire defined experimental animal population. It is determined from the exposure to the substance of a significant number from that population.

Table 35. ROUTES OF ADMINISTRATION TO, OR EXPOSURE OF ANIMAL SPECIES TO TOXIC SUBSTANCES IN LAB TESTS (Lewis and Tatken, 1979.)

Route	Abbreviation	Definition
Eyes	eye	Administration directly onto the surface of the eye. Used exclusively for primary irritation data. See Ocular.
Intradermal	idr	Administration within the skin by hypodermic needle.
Inhalation	ihl	Inhalation in chamber, by cannulation, or through mask.
Intramuscular	ims	Administration into the muscle by hypodermic needle.
Intraplacental	ipc	Administration into the placenta.
Intraperitoneal	ipr	Administration into the peritoneal cavity.
Intravenous	ivn	Administration directly into the vein by hypodermic needle.
Ocular	ocu	Administration directly onto the surface of the eye or into the conjuctival sac. Used exclusively for systemic data.
Oral	orl	Through the mouth, intragastric, feeding, or introduction with drinking water.
Percutaneous	per	Absorbed through the skin.
Skin	skn	Application directly onto the skin, either intact or abraded--used both for systemic and primary irritant effects. (see below)
Subcutaneous	scu	Administration under the skin.

Toxic substances are tested on animals since potentially dangerous experiments cannot be done on people. Mice and rats are most commonly used for such tests because they are easily handled and economical, and react similarly to humans in their response to chemicals. They therefore provide the most useful data for comparisons. Rabbits, guinea pigs, and monkeys are other commonly used test species.

Test animals are exposed to much higher doses than the low levels at which humans are most often exposed. This is because lengthy tests with many subjects are expensive, and the chronic effects which are caused by long-term, low level exposure may also be produced by the short-term, high level dosage. Also, test animals such as rats have a two to three year natural lifetime and can thus show chronic (to rats) effects such as cancer in a relatively short period. For more information on this point, see National Cancer Institute, 1979.

The units used to express toxic dose require a quick explanation. As in almost all toxicological experiments, the doses are expressed in terms of the amount of chemical administered per unit body weight, or quantity per unit volume of air. Depending on the experiment, the duration of time (e.g., 96 hours) over which the dose was given is also expressed. The most common unit of measurement is milligrams per kilogram (mg/kg), but sometimes grams per kilogram (g/kg) or micrograms per kilogram (ug/kg) may be used. When the substance is a gas, the concentrations are given as parts of substance per million parts of air by volume (ppm), and sometimes as parts per hundred (pph) or parts per billion (ppb). If the substance is a solid or a liquid suspended in air, then the concentrations are usually expressed as milligrams per cubic meter of air (mg/m^3), or, in some cases, as micrograms per cubic meter (ug/m^3).

3. Toxic Effects

Acute and chronic effects depend on how toxic the substance is, and what the dose is. And, in the case of chronic toxicity, the frequency of exposure is also important.

Acute effects are the ill effects that occur immediately after exposure to too much of a toxic substance. For example, getting jittery after you drink coffee or soda pop with caffeine is an acute attack. Acute effects are often reversible, in that they may heal or go away with time.

Chronic effects are the ill effects that do not appear immediately but do appear after a period of time. Chronic effects often occur at doses too small to produce acute effects. A single acute exposure to some substances in early pregnancy may produce a baby with a birth defect, which is a chronic effect. On the other hand, repeated cigarette smoking (chronic exposure) might not lead to the development of lung cancer (a chronic effect) until many years after the person started smoking. Chronic effects are often irreversible -- once you have a birth defect, it will not heal.

One kind of toxic effect that can occur is an irritation. Toxic substances that are applied to the skin or mucuous membranes can result in systemic or local effects, the latter being termed "primary irritation." A primary skin or eye irritant is defined as "a chemical substance that produces an irritant response on first exposure in a majority of the test subjects" (Lewis and Tatken, 1979). There are many kinds of chronic effects. Some of the most common are:

- Liver or kidney damage: Organs that are primarily concerned with breaking down and getting rid of toxic substances in the body are damaged.

- Central nervous system (CNS) damage: Damage to the CNS (nerve cells in the brain and spinal cord) can be exhibited in minor ways, such as depression or slight changes in I.Q., or can consist of serious damage, such as paralysis.

- Cancer: The appearance and proliferation of abnormal and destructive tumor-producing cells can result from exposure to a cancer-causing agent, called a carcinogen. Some substances are indirect carinogens, i.e., they may damage certain body cells which then become more sensitive to other "cancer promoters" (Sasnett, 1979). Some carcinogens have synergistic effects on each other in that the risk of cancer may be increased if exposed to two carcinogens at the same time.

- Neoplasm: The appearance and proliferation of tumor or growth cells which may not be abnormal and which do not invade and destroy other tissues may result from some chemical exposures. These tumors or growths may be benign or malignant (Lewis and Tatken, 1979).

- Mutation: A change in the genetic material of sperm or egg cells can lead to an undesirable inherited condition and can be caused by exposure to mutagen. A mutation is inheritable from cell to cell but not necessarily from individual to individual (Segal *et al.*, 1980). The effect may be a subtle change, such as decreased resistance to disease, or a gross malformation such as a birth defect.

- Teratogenic effect: A birth defect produced by a disturbance of natural development of a fetus during pregnancy can be caused by exposure to a teratogen. The effect can also be subtle (e.g., a learning disability) or a gross deformation. Only pregnant women are subject to the effects of teratogens.

C. TOXIC VERSUS HAZARDOUS

What precisely is the difference between "toxic" and "hazardous?" Dictionary definitions present toxic as "poisonous" and hazardous as "dangerous." The terms, however, are often used interchangeably -- including in this project and its reports -- and much confusion exists over their specific meanings. The Chemical Specialties Manufacturers Association recommends a clear distinction:

> The term "toxicity" means the net effect of a substance or other agent on an organism, while "hazard" represents a significant risk of harm in a particular situation. All substances or agents have some degree of toxicity, but a hazard exists only if the exposure presents a significant risk of adverse effect. Toxicity is not equivalent to hazard, and [one] should refrain from characterizing products or chemicals as hazardous without assessing the potential risk (CSMA, 1982).

In legal and general usage, however, such distinction is not made. Definitions from various federal laws are as follows:

- Hazardous waste (RCRA): A solid waste substance that may "cause or significantly contribute to..." serious illness or death or "pose a substantial present or potential hazard to human health or the environment" when improperly managed;

- Toxic substance (TSCA): A chemical whose manufacture, processing, distribution, use or disposal "may present an unreasonable risk of injury to health or the environment;"

- Hazardous substance (Clean Water Act): An element and compound which, "when discharged in any quantity into or upon [water]..., present[s] an imminent and substantial danger to the public health and welfare...;"

- Toxic pollutant (Clean Water Act): A substance which, "after discharge and upon exposure, ingestion, inhalation or assimilation into any organism..., will, on the basis of information available..., cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring;"

- Hazardous substance (Federal Hazardous Substances Act): Any substance which "may cause substantial personal injury or substantial illness during...any customary or reasonably foreseeable handling or use;"

- Hazardous air pollutant (Clean Air Act): A substance which "causes, or contributes to, air pollution which may reason ably be anticipated to result in an increase in mortality or an increase in serious...illness;"

- Hazardous material (Hazardous Materials Transportation Act): A substance or material which is "capable of posing an un reasonable risk to health, safety, and property when transported in commerce..."

Almost all of these definitions, whether of toxic or hazardous, refer to an assessment of risk and use such qualifiers as significant, unreasonable, substantial, or reasonably anticipated.

In general, hazardous is a more inclusive term and refers to materials that pose a threat or risk of injury -- are dangerous -- because they are explosive, corrosive, flammable, reactive, or toxic. Toxic, in its common usage, refers to materials that pose the specific threat or risk of injury of poisoning (in its broadest sense) producing an adverse biological effect in the exposed organism or its offspring. Toxic in this usage is a subset of hazardous, and does connote hazard or risk.

In this Household Hazardous Waste Disposal Project and throughout these reports, toxic is used in this manner (i.e., a specific class of hazardous) and hazardous is generally used to refer only to its toxic class. Where the word "hazardous" is seen (as in Household Hazardous Waste), read "toxic hazardous."

APPENDIX B

PRODUCT DISPOSAL RECOMMENDATIONS (MODIFIED)

A. BASIC INFORMATION

1. General Precautions

a. Wastes should not be mixed together.

Exceptions:

- brake and transmission fluids can be mixed with oil
- waste paints of different colors but same types can be mixed together (e.g., oil base with oil base and water base with water base.)

b. All chemical wastes should be kept out of the reach of children or pets.

c. The labels should always be read carefully and thoroughly for precautions on handling before using any household chemicals.

d. Skin contact and breathing of fumes should be avoided.

2. Handling

a. All household hazardous waste should be handled with care during transportation. Usually the original container is the best choice; if it is not available, something approximating it as closely as possible should be used.

b. Special attention should be given to ventilation in order to avoid breathing the fumes from waste materials (which may build up in an enclosed space, such as an automobile).

3. Poisonings, Spills and Explosives

a. Poisonings. For information on:

- health effects of consumer products
- potential poisonings
- actual poisoning emergencies

Call Poison Control Center
634-5252 (Seattle)

b. Spills of Small Quantities (homeowner).

- 24 hour response
  - -- Washington Department of Ecology
    885-1900 (Redmond)

c. All Other Spills -- large quantities, on land or water.

- 24 hour numbers
  - -- Washington Department of Ecology
    885-1900 (Redmond)
  - -- Seattle Fire Department Hazardous Materials Team
    911 (Seattle only)
  - -- EPA
    442-1263 (Seattle)
  - -- Coast Guard
    441-1853 or 442-1856 (Seattle)

d. Spills or Illegal Discharges into Metro Sewer.

- 24 hour
  - -- Renton Treatment Plant: 226-3680
  - -- West Point Treatment Plant: 447-6803
- Not 24 hour
  - -- Denise Healy: 447-6747
  - -- Bruce Burrow: 447-6836
  - -- Doug Hilderbrand: 447-6743

e. Explosives.

-- 625-2625 (Seattle)

-- 344-5250 (King County)

B. PRODUCT DISPOSAL INFORMATION

1. Automotive Products

a. Oil. Waste oil should be recycled at local full-service gas stations. We recommend that people call the gas stations first to make sure that the station will take the oil. Alternatively, they can call 1-800-RECYCLE and ask for the gas station closest to their home. Gasoline should not be added to oil.

b. Transmission Fluid. Transmission fluid can be added to oil and recycled as well.

c. Gasoline. Uncontaminated gasoline should be used up in an automobile or other engine. Using gasoline as a solvent (e.g., to clean tools) can contaminate it. We do not advise this practice due to the possibility of flammability and adverse health effects, and because of the problem associated with the disposal of the contaminated gasoline. (Kerosene, diesel fuel or regular solvents are preferable for tool cleaning and related purposes; kerosene and diesel fuel are not as flammable as gasoline and can be mixed with waste oil for recycling.)

Gasoline must be handled with extreme care -- it is one of the most hazardous (flammable, combustible, poisonous) substances found around the home.

Contaminated gasoline should be taken to Northwest Tank Service, Inc. for proper disposal. Call them at 622-1090. (This is the only company known to accept this waste at this time).

d. Antifreeze, Brake Fluid. Call Metro Toxicant Control at 447-5885.

e. Batteries. Automobile batteries should be recycled, repaired and reused. Contact a local battery shop (listed in yellow pages under "Batteries-Storage-Retail").

2. Pesticides (Includes insecticides, herbicides, fungicides, disinfectants, etc.)

a. Disposal. Waste pesticides should not be disposed of in the trash or down the drain.

All unwanted or waste household pesticides should be taken to a designated collection site. Depending on where the citizen lives, he can take his pesticides to one of the four Seattle-King County Health Department District offices or to Chemical Processors, Inc. Both Chemical Processors, Inc. and the Health Department want the citizen to call them first; no unannounced drop-offs are allowed. (Chemical Processors is the only company known to accept pesticides at this time).

The phone numbers are:

--	SE Health Department	228-2620
--	E Health Department	885-1278
--	N Health Department	363-4765
--	Central Health Department	363-4765
--	Chemical Processors, Inc.	767-0350

If the container is torn, broken or leaking, see the precautions under spill cleanup below.

Empty pesticide containers should be triple rinsed, and the rinse water used as a pesticide. The container should then be wrapped securely in a plastic bag or newspaper and disposed of with other household refuse.

Further questions on disposal may be directed to:

-- Washington State Department of Ecology
885-1900 (Redmond)

b. Spills. For information and instructions in the event of a spill, call:

-- Washington State Department of Ecology
885-1900 (Redmond)

General recommendations for spill cleanup:

- Liquids:

-- Keep people and pets away from area. Ventilate area.
-- Put on rubber (preferable neoprene) gloves.
-- Do not walk in spilled material unless wearing rubber boots or plastic covering over shoes.
-- Add absorbent material (kitty litter, disposable diapers, sawdust, paper towels, old rags) -- enough to soak up all excess liquid.
-- Sweep and scoop into a paper bag, then place in plastic bag (or place directly in heavy duty plastic bag.)
-- Call DOE, 885-1900, for specific ways to clean up residue and further instructions for disposal.

c. General Inquiries.

- Questions concerning use of pesticides:

-- King County Cooperative Extension Service -
Master Gardener 344-4162

- Questions/Complaints about pest control operators (indoor pests)

  -- Seattle-King County Health Department
  625-2125

  -- Washington State Department of Agriculture
  753-5064 (Olympia)

- Questions/Complaints about pesticide applicators (outdoor pest control - ornamentals, fruits, etc.)

  -- Washington State Department of Agriculture
  753-5064 (Olympia)

- Questions/Complaints about roadside weed control

  -- King County Office of Public Works - Jan Klippert
  344-7302

  -- Seattle-King County Health Department;
  625-2125

- Questions/Complaints about pesticide applicators of aquatic herbicides

  -- Metro
  447-4816

- Pesticide mistakes by homeowners (sprayed my fruits and vegetables with _________________; can I eat the fruit?)

  -- King County Cooperative Extension -
  Dial Extension Tape #421 344-7680

- Licenses (to use, sell or recommend certain categories of pesticides)

  -- Washington State Department of Agriculture
  753-5064 (Olympia)

- Pesticide education (short courses, publications, Dial Extension Tapes)

  -- King County Cooperative Extension Service
  344-2686

3. Paint Products

a. Solvents. Solvents can be reused, recycled or occasionally reprocessed. Call Metro Toxicant Control (447-5885) for recommendations.

b. Paints. Paints should be used up or given to others to use, if possible. Some charities and community organizations will accept excess or waste paint. Call Metro Toxicant Control (447-5885) for recommendations. If paints cannot be reused or donated, the solvents in the paint may be evaporated in small quantities in a covered outdoor area (with all due precautions as to fire and health hazards taken) and then the remaining sludge disposed of with other household refuse.

c. Preservatives. Preservatives should be treated as pesticides.

4. Household Cleaners

a. General Comments. Household cleaners include a range of cleaning and disinfecting products, such as disinfectants, bathroom cleaners, drain cleaners, furniture polish, dry cleaning fluid, bleach, oven cleaner, abrasive powder, air fresheners, floor cleaners and waxes, rug cleaners, upholstery cleaners and window cleaners, as well as laundry products such as detergents, fabric softeners and additives This bewildering profusion of cleaners makes this class of products difficult to examine. Within each type of product, there are tens and sometimes hundreds of different formulations for specific uses and brands, and these formulations change over time and over geographical area.

Unlike many other toxic products, household cleaners pose a problem not as much through their disposal as through their use. Cleaners normally are not disposed of, in the sense that excess or leftover quantities of the substances are considered waste and dumped; instead, they would tend to enter the environment through their everyday use. We encourage the conservative use of household cleaners. If the caller has a quantity of usable cleaner that they want to dispose of, attempt to find someone who could use it. Hospitals, schools or emergency housing sites may be places that would need cleaners.

No specific recommendations have been developed for the disposal of cleaners. A few comments are in order, however:

- Use of septic tank cleaning compounds containing organic solvents (e.g., 1,1,1-trichloroethylene) is NOT encouraged. These solvents are persistent, toxic and mobile, and their use has been shown to contaminate groundwater.
- Aerosols should be used and disposed of with great caution, as excess heat or pressure (as during garbage truck compaction) can cause explosions.

- Call Metro Toxicant Control (447-5885) for information on specific disposal concerns.

b. Alternatives. Many alternatives exist for the use of safer or more benign household cleaners. Information on alternatives is available in the following references:

- "99 Ways to a Simple Lifestyle" (Center for Science in the Public Interest, 1977);
- "The Household Pollutants Guide" (Fritsch, 1978);
- King County Cooperative Extension at 344-7680.

APPENDIX C

Solid Waste Technical Staff 11/3/81

GUIDELINES FOR FIELD OPERATION OF PESTICIDE/HERBICIDE COLLECTION PROGRAM

The District Health Offices will soon be responding to callers who have questions concerning proper pesticide/herbicide disposal. The District Environmental Health Staff should be able to explain to such callers the disposal option(s) available to them. One alternative the public will have is to bring their leftover pesticides to a District Health Office. For this purpose, hazardous waste barrels will be distributed to each of the District offices to be kept in an area well ventilated and inaccessible to the public. One sanitarian from each district office will be District designated as "lead person" responsible for advising the public. This individual will also be expected to receive pesticides by appointment from the public and manifest them for storage. The pesticides that the sanitarian receives must be in their original container and identifiable.

The following are the Health Department's recommendations for proper disposal of pesticides:

1. Use product up or give it to a neighbor/friend who will do same.
2. Bring unused portion of pesticide/herbicide in original container to District Health Officer.
3. If pesticide/herbicide is in a container(s) exceeding 1 cubic foot in total volume, take product to a chemical processing company (i.e., Chemical Processors, Inc., 5501 Airport Way South, 767-0350).

The public can put empty pesticide containers in the trash if they have been triple rinsed or, in the case of aerosol containers, their gases have been completely vented.

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APPENDIX C
SOLID WASTE TECHNICAL STAFF GUIDELINES (continued)

CHEMICAL CLASS	COMMON NAME	TRADE NAME(S)	PURPOSE FOR WHICH USED	RELATIVE TOXICITY (1 HIGH- 4 LOW)	RECOMMENDATION(S) FOR DISPOSAL IN ORDER OF PREFERENCE
Organo-Phospnate	Malathion	Cythion	Fruits, Vegetables, Livestock	4	1,2,3
Organic	Pyrethrin		Household, Garden Spray	4	1,2,3
Organo-Phosphate	Acephate	Orthene	Aphids, Caterpillars	4	1,2,3
Organo-Phosphate	Ronnel	Trolere, Korlan	Fly Control		1,2,3
Organic	Coumarin	Warfarin	Anticoagulant Roenticide		1,2,3
Organic	Rotenone	Derris, Cube	Dog-Cat Fleas Vegetables		1,2,3
Carbamate	Carboryl	Sevin	Residual, Contact Insecticide		1,2,3
Chlorin. Hydrocarbon	Lindane	Quell	Household Wood Insects, Head Lice		2,3
Molluscicide	Metaldehyde	Metason, Halizan	Slug & Snail Bait		1,2,3
Chlorin. Hydrocarbon	2,4-D	Weed-B-Gon Lawn-Keep	Controls Broad Leaf Weeds		1,2,3
Chlorin. Hydrocarbon	Dichlobenil	Casoron	Seedling Growth Inhib.		1,2,3
Organo-Phosphate	Glyphosate	Kleen-Up Round-up	Post. Emergency Herbicide		1,2,3
Organo-Phosphate	Diazinon	Spectracide	Vegetables, Fruit Cockroaches	3	1,2,3
Organo-Phosphate	Naled	Dibrom	Fly & Mosquito		1,2,3
Organo-Phosphate	Trichlorfon	Dylox, Anthon	Fly Control		1,2,3
Organo-Phosphate	Chlorpyrifos	Dursban	General Turf & Household Insecticide		1,2,3
Chlor. Hydrocarbon	P.C.P.	Permite Penta-Kil Durotox	Insecticide, Fumicide Preservant		1,2,3
Chlor. Hydrocarbon	D.D.T.		General Insecticide	3	2,3
Organophosphate	Dichlorvos	Vapona DDVP	Fumigant Fly Control	2	1,2,3
Organophosphate	Disulfoton	Disyston	Systemic Pesticide	1	2,3
Hydro. Chlorinated	Chlordane	Niran, Belt	Soil Insects	3	2,3
Organophosphate	Parathion	Alkron, Paramar	Fruits, Vegetables	1	2,3
Chlor. Hydrocarbon	Aldrin	Aldrex	Soil Treatment	2	2,3
Chlor. Hydrocarbon	Dieldrin	Octalox Dieldrix	Seed & Structural Pest Control Work	2	2,3
Chlor. Hydro.	Kepone	GC1189	Ant & Cockroach Control	4	2,3
Chlor. Hydro.	Mirex	Dechlorane	Ant Control	3	2,3
Chlor. Hydrocarbon	Silvex	Kuron, Weedone	Postemergent Plant Control	4	2,3
Chlor. Hydro.	Heptachlor	Drinox, H-34	For Wood Boring Insects	3	2,3
Chlor. Hydrocarbon	2,4,5,-T		Postemergent Plant Control	3	2,3
Chlor. Hydroc.	Toxaphene	Attac, Camphloclor	Comm. Crop Usage	3	2,3

Should questions arise regarding proper disposal of products not listed above, contact either Wally Swofford or Greg Bishop at 625-2125 for further information.

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